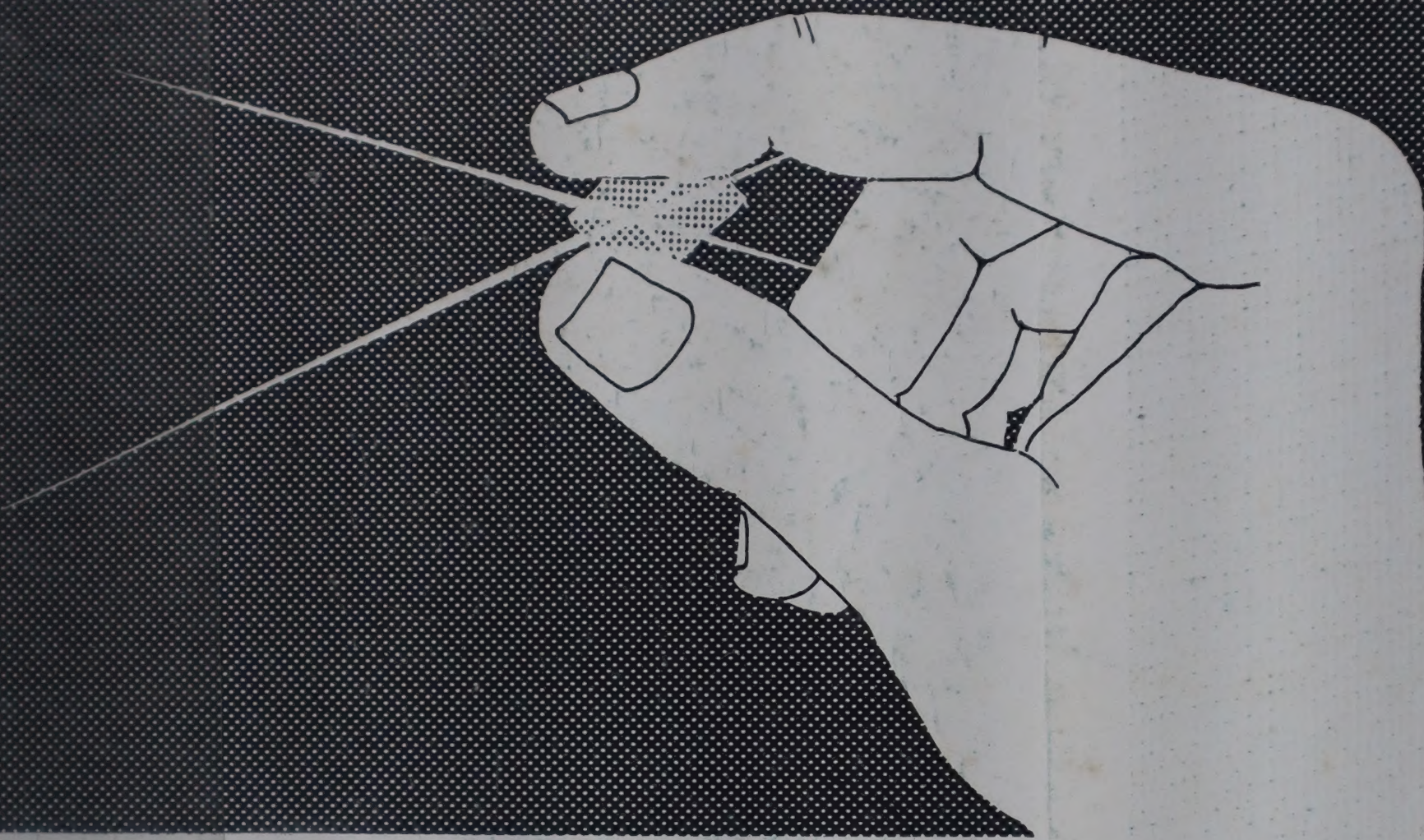


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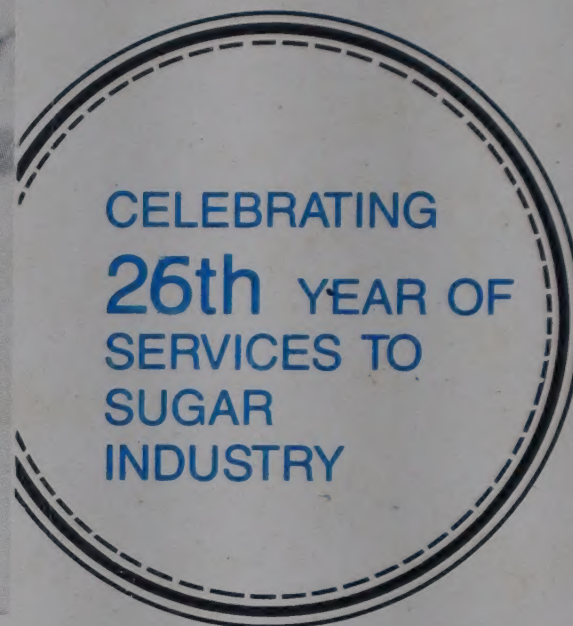
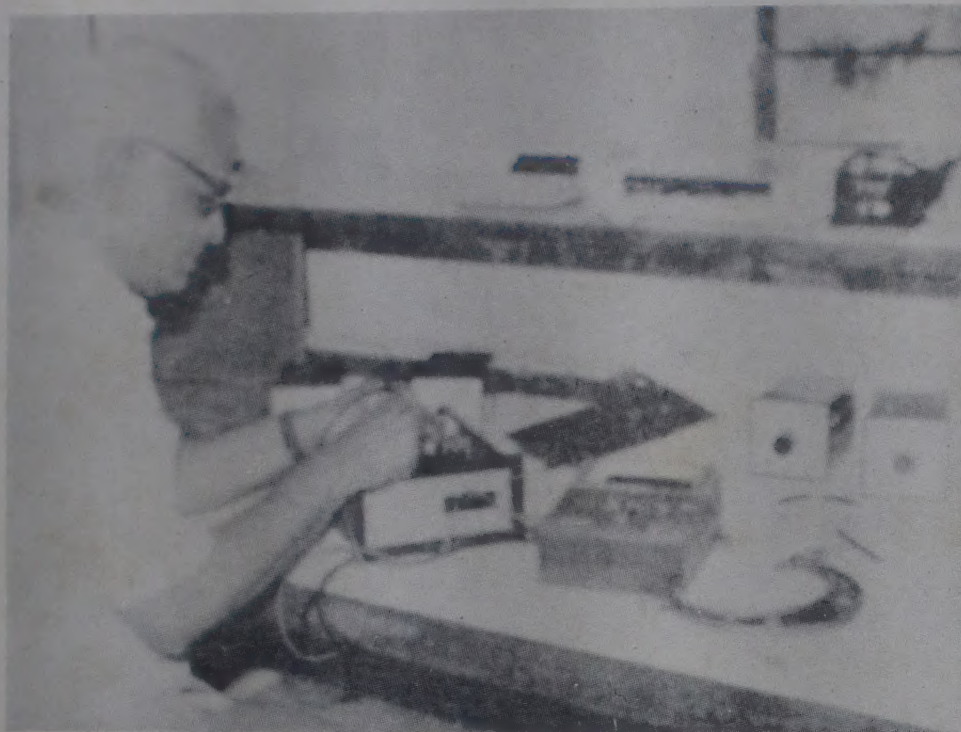


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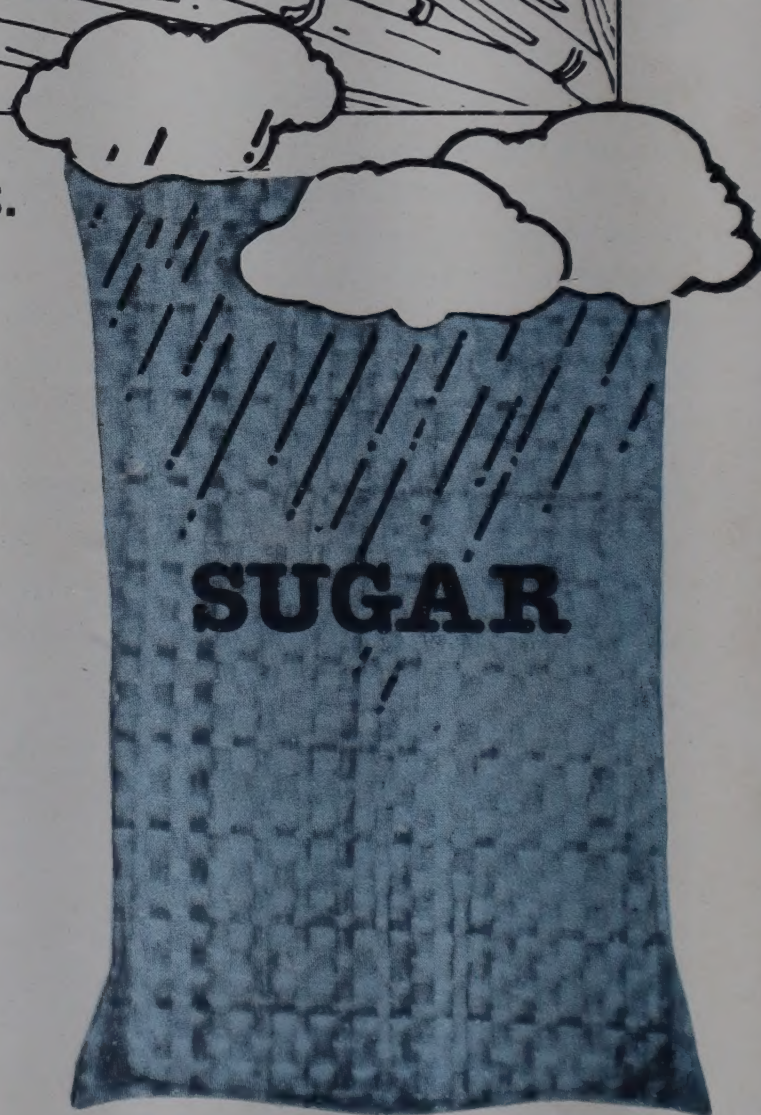
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PREFACE

We are happy to present to our patrons and sympathisers this Second Edition of "Directory of the Sugar Industry". It pertains to the years 1987 and 1988. At the outset we offer a sincere apology for the somewhat delayed publication of the second volume and we record this regretful trespass on the patience of our well-wishers. We may, however, be permitted to reiterate the mitigating circumstance that our oft-repeated requests to our several constituents for facts and figures evoked unconsciously delayed response. Without the receipt of this essential information our Directory would have presented a rather truncated version of the contemplated compendium and we had to risk late publication. We, however, venture an assurance on this occasion, that every precaution has now been planned and designed to prevent such sad recurrence and our readers can now hope to receive the third and successive editions promptly on precise and pre-declared dates.

The happy circumstance noted in the previous edition can again be restated : the pre-eminence of the Indian Sugar Industry on the world sugar map. By registering a production of around 8.5 million tons of sugar in the year 1986-87, inspite of several impediments offered by adverse conditions of weather and industrial sickness, the Indian Sugar Industry bids fare to achieve a succession of laurels in years to come so that its entry into the 21st Century cannot be anything but a triumph in relation to this vital requirement of the Indian people. Our progress thus far is most potent and indicative of the vast changes this industry is destined to witness and experience. "Changes" is hardly the exact word, "revolution" would be more appropriate. The almost somnolent saunter of the Indian Industry before independence has surely been replaced by a fierce and wakeful advance into a new haven of self-reliance. The century which is now poised to disappear behind the inevitable curtain of time is being replaced

by a century which is sure to gift the Indian Industry new and splendid attitudes, beneficial modes and readier acceptances of bolder norms of living. The Indian Scientists and Technologists, the twin harbingers of glory, glamour and life enrichment, with undreamt of novelty and plenty, are fully equipped to perform this historical task. They are advancing the R and D frontier at unprecedented speed towards a horizon of breath-taking breadth and depth. Sugar Industry is but one such example of this planned progress which is to achieve an overall growth rate of over 5% p.a. This is designed to be done by increasing productivity, upgrading technology, introducing balancing equipments and improving the infra-structure by removing constraints. This is the thrill-spangled vision of the 21st century sugar industry. The two pillars of this hope for progress are surely the strengths emanating from the latest advances in Bio-technology and Automation. These two are the catalysts and the impetus behind the expected phenomenal leap of the Sugar Industry into the vital 21st Century. The pages of this Directory will bear evidence of the reality of this plan, which may appear to be some what of a dream but indeed is a pragmatic target.

This target is based on vital statistics that daze and dazzle the threshold of the impending century. Briefly stated, they are:

- | | |
|------------------------------------|------------------|
| 1) Per Capita Consumption of Sugar | 14.25kg/year |
| 2) Population | 916 million |
| 3) Internal requirement of Sugar | 13 million |
| 4) Export Target | 1.5 million tons |

All this would indicate our total requirement of sugar in 2001 A.D. to be 14.5 million tons. This ambition is quite moderate and realistic. It is sure to be exceeded even, if destiny is inclined to favour our developing nation with a splendid chance to establish a covetable reputation as an efficient, modern

and go-getter nation ranking almost at par with U.S.A., U.K., U.S.S.R., Japan, France, Germany etc.. The ensuing pages of this Directory strive to evidence this excellence with the assistance of a better managerial framework and net-ethic.

It must be admitted, however, that our sugar industry, of late, seems to have been ensnared in a whirl of seemingly insurmountable difficulties in common with the other leading Indian Industry, namely, the textile. Sickness is becoming endemic and there is cause for some alarm and despondency. Remedial steps are an urgent necessity.

The sugarcane producer is sore about the monetary returns, especially in view of the rapid rise in the prices of the essential inputs. There are a number of other crops capable of offering high profits with greater certainty and the situation needs careful watching. Sugar-farm technology is crying out loud for adoption of better standards. The average yield must be improved to 75 tonnes per hectare from the present 55 tonnes even as 100 tonnes is a feasible target. The current recovery of 10% of sugar needs to be advanced to 11%. The curses of inefficiency illiteracy, poverty, etc. all these must be banished from the life of an average Indian as also from the Industry.

It is the prime duty of our technocrats and they must apply every ounce of their innovative energy for eradicating inhibitions mentioned above.

Fuel efficiency and energy conservation must be accorded priority so also the problem of producing additional wealth from the by-products of this industry. This is a major, albeit most neglected, challenge to the industry. This directory lays special emphasis on this vital requirement, especially the problem of recovering energy from spentwash. Radical method like employing Incineration Boiler has got to be given a fair trial. Government has already been apprised of the necessity and parameters of this interesting solution. With the considerable financial assets available with the Government as a result of the collections from the sugar industry this task appears easy to achieve and the Government must expedite its decision in a positive manner.

As referred to discreetly in the first edition, the prominent and unprecedented feature of our sugar industry happens to be its locale. Almost all the 355 sugar factories are located in the rural sector. This fact has augmented the rural employment and rural income for the first time in India. The rural India has only now begun to converse effectively with its urban counterpart, an integration of splendid dimensions. The rural India promises to be more autonomous due to educational, management and technical skills resulting from the new prosperity introduced by the sugar industry.

Our vision of rural India reaches beyond establishing, piggeries, poultries, dairies etc.. We must envision the growth and development of this sector of our nation as a new centre of advancement, par excellence, of information, knowledge and wisdom which will, in turn, be the foundation of extended hierarchies of agriculture, education, health and finally socio-economic-cultural excellences of life itself. Sugar Industry is by this token the new inspiration for the vaster total life of India. It exemplifies the nature and extent of rural population's hopes, expectations and life-force. For the first time, they have been enabled to articulate their perceptions and legitimate desires. For the first time, too, they are participating in the total Indian effort and work load for prosperity. It lends them dignity, self-respect and will offer, in time, affluence. They can now see how a national resource can be processed and converted into superior end-products through science and technology and this is the basic educational enlightenment of this and future rural generations and techno-managerial work ethos. Government on its part, has begun to create an enabling environment to better the future stature of this industry and people engaged in it. In this, we perceive the seeds of happier future and our Directory, it is modestly claimed wishes to establish its right to witness and record the onward march of this "Ratha-Yatra" in all its splendour : Technical, Scientific, Financial, Commercial etc..

We would welcome the views, comments and suggestions of our readers so as to render our future efforts a better shape and usefulness.

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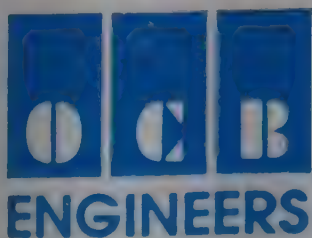
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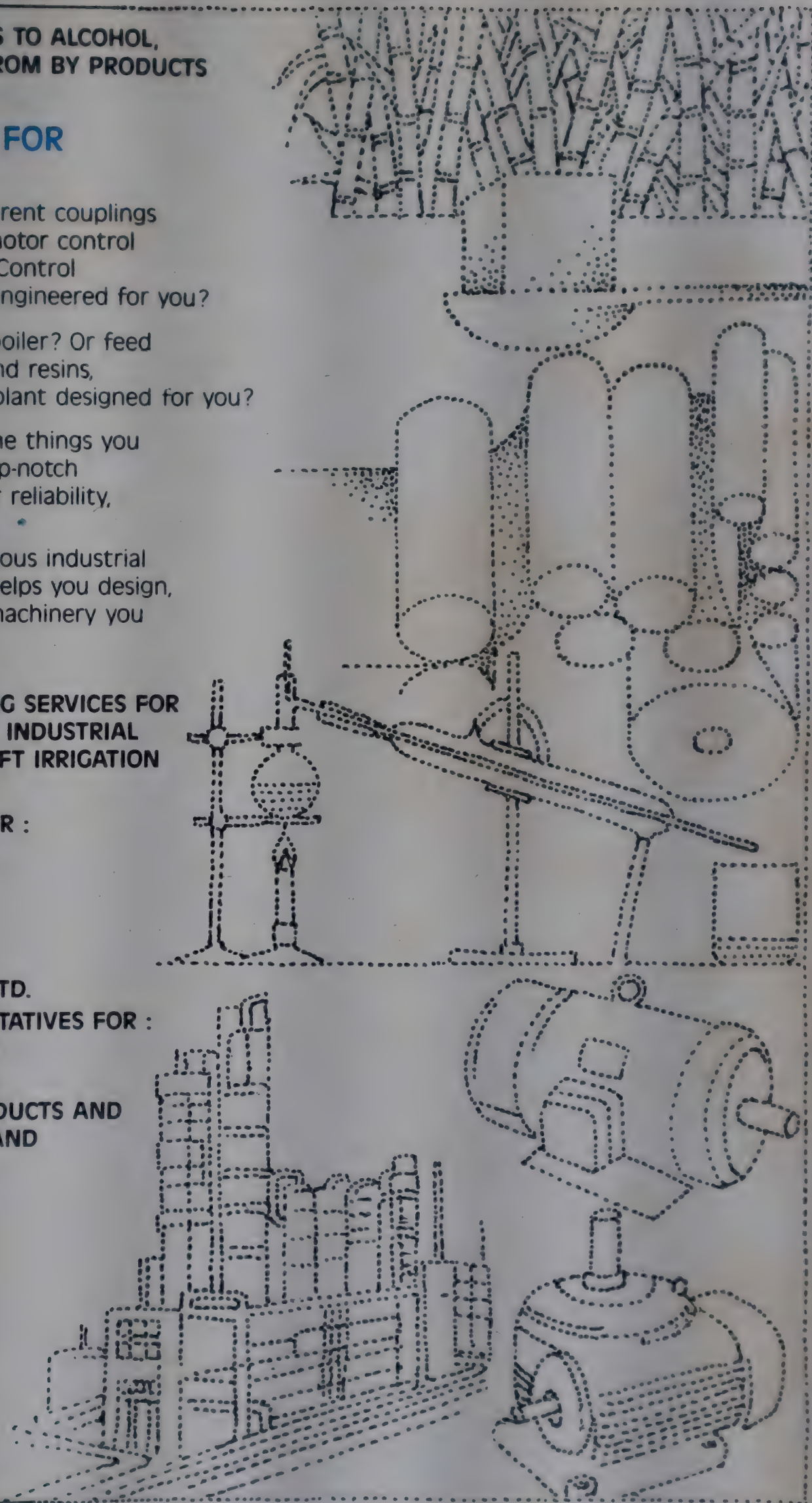
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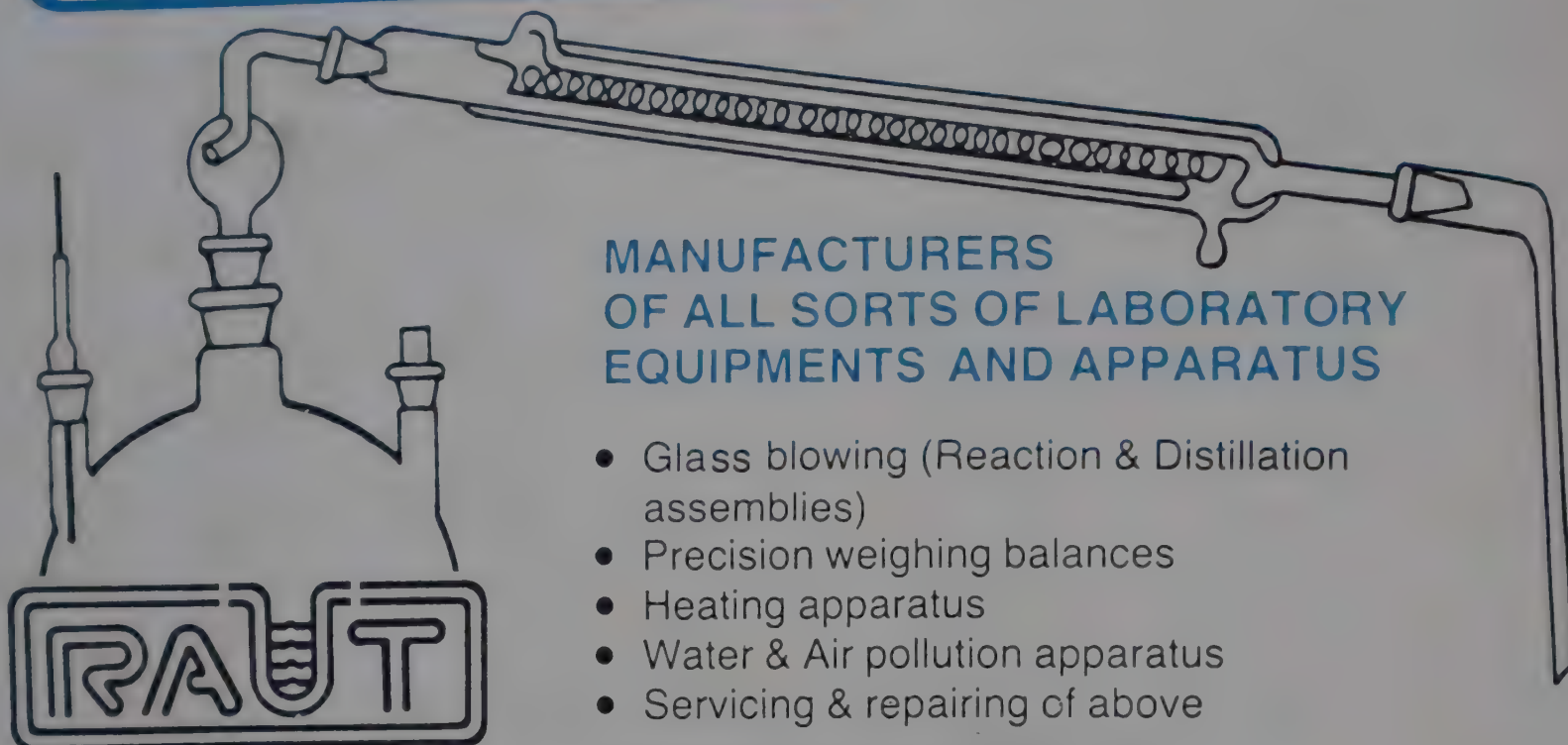
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11.	National Heavy Engg. Corporation Ltd.	Poona	6	3	15.	Hindustan Dorr Oliver	Bombay	93	3
12.	Parkhe Consultants Pvt. Ltd.	Poona	13	3	16.	Electron & Electrons	Poona	95	3
13.	Praj Conseltech	Poona	21	3	17.	Elecon Engg. Co.	Vallabh Vidyanagar	104	3
14.	Prem Heavy Engg. Works Pvt. Ltd.	Meerut	9	3	18.	Electric Chain Hoist	Bombay	114	3
15.	Servall Engg. Works P. Ltd.	Coimbatore	16	3	19.	Energy Society	New Delhi	96	3
16.	Spraymetal Pvt. Ltd.	Bombay	14	3	20.	Extract Engg. Works	Ahmednagar	94	3
17.	Texmaco Ltd.	Calcutta	11	3	21.	Filtron Engg. Pvt. Ltd.	Poona	97	3
18.	Trinetra Associates	Poona	23	3	22.	Garware Wall Ropes Ltd.	Bombay	98	3
19.	The Triveni Engineering Works Ltd.	Delhi	7	3	23.	Hiralal & Co.	Poona	102	3
20.	The Triveni Engineering Works Ltd.	Allahabad	8	3	24.	Hoist-O-Mech.	Thane	99	3
21.	The Triveni Engineering Works Ltd.	Bangalore	10	3	25.	Indiana Engg.	Bombay	100	3
22.	Vista Consulting Technologists & Engg. Co. Pvt. Ltd.	Poona	15	3	26.	Ingersoll Rand (India) Ltd.	Bombay	123	3
23.	Walchandnagar Industries Ltd.	Bombay	12	3	27.	Jagat Machinery Mfg. Pvt. Ltd.	Ghaziabad	101	3
Manufacturers & Suppliers					28.	Jagriti Industries Supp. & Mfrs.	Shrirampur	119	3
1.	Advance Dynamics	New Delhi	82	3	29.	J. N. Engg.	Sangli	86	3
2.	Ahinjar Fabricators & Erectors	Kolhapur	82	3	30.	Jyoti Ltd.	Vadodara	105	3
3.	Amba Prasad Jain & Co.	Meerut	120	3	31.	Mahashakti Engg. Co.	Ghaziabad	103	3
					32.	Maya Engg. Works	Karad	104	3
					33.	Meerut Engg. Works	Meerut	106	3

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34.	Oriental Engg. Co.	Poona	104	3
35.	Ramon Rom Equipment Services Pvt. Ltd.	Poona	109	3
36.	Ravalgaon Sugar Farm Ltd.	Bombay	112	3
37.	Richardson & Cruddas (1972) Ltd.	Bombay	107	3
38.	R. R. Pollution Indl. Controllars	Navsari	108	3
39.	Sanjivani Engg. Works	Kopargaon	113	3
40.	Sadhu Singh & Sons	Yamuna Nagar	124	3
41.	Samarth Engg. Works	Kopargaon	124	3
42.	Sapphire Engg. Co.	Ghaziabad	124	3
43.	Shrijee Engg. Works	Bombay	111	3
44.	Sonar Airotech	Calcutta	116	3
45.	Span Industries	Kolhapur	114	3
46.	Spavy Industries	Satara	116	3
47.	S. J. Engg.		116	3
48.	S. S. Engineers	Poona	117	3
49.	Sugfab Corporation	Meerut	118	3
50.	Surendra & Co.	New Delhi	110	3
51.	Swam Pneumatics Pvt. Ltd.	Ghaziabad	115	3
52.	Trimurti Sales Pvt. Ltd.	Poona	121	3

Consultants

1. Capital Management & Services	132	3
2. Cholamandalam Software Ltd. Madras	138	3
3. Engg. & Technical Services	Allahabad 131	3
4. Engineers Consortium	New Delhi 132	3
5. Kale Consultants	Poona 132	3
6. Kirloskar Consultants Ltd.	Poona 133	3
7. Loyli Engg. Pvt. Ltd.	Poona 134	3
8. Poddar Management & Tech. Services	Desanur 137	3
9. Sucro Consult International	New Delhi 135	3
10. Technical Devp. & Application	Poona 136	3

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Sugar Factories				
1.	Ajinkyatara SSK. Ltd.	Shahunagar Shendre	8	1
2.	Ambajogai SSK Ltd.	Ambasakhar	27	1
3.	The Andhra Sugars Ltd.	Venkatarampuram	48	1
4.	Ashok SSK Ltd.	Ashoknagar	177	1
5.	Balasaheb Desai SSK Ltd.	Daulatnagar	149	1
6.	Bhima SSK Ltd.	Patas	6	4
7.	Shri Bhogawati SSK Ltd.	Shahunagar	150	1
8.	Shri Bhogawati SSK Ltd.	Tulshidasnagar	249	1
9.	Sri Chaltan Vibhag Khand Udyog S. M. Ltd.	Chaltan	28	4
10.	Sri Chamundeswari Sugars Ltd.	K. M. Doddi	2	1
11.	The Chodavaram Coop. Sugar Mills Ltd.	Govada	29	4
12.	Shri Datta SSK Ltd.	Shirol	73	4
13.	Daulat SSK Ltd.	Halkarni	46	1
14.	Shri Dudhganga Vedganga SSK Ltd.	Bidri	182	1
15.	Shri Dnyaneshwar SS Ltd.	Dnyaneshwar Nagar	222	1
16.	Gadhinglaj Taluka SSK Ltd.	Gadhinglaj	164	1
17.	Gangapur SSK Ltd.	Gangapur	359	3
18.	The Ghatprabha SSK Ltd.	Gokak	50	4
19.	The Girna SSK Ltd.	Bhausahenagar	240	1
20.	The Godawari Dudhana SSK Ltd.	Pathri	47	4
21.	Shrigonda SSK Ltd.	Shrigonda	370	3
22.	Shri Hiranyakeshi SSK Ltd.	Sankeshwar	67	4
23.	Hindustan Sugar Mills	Bombay	357	3
24.	Hutatma Kisan Ahir SSK Ltd.	Walwe	47	1
25.	Shri Jagadamba SSK Ltd.			
26.	Jai Jawan Jai Kisan SSK Ltd.	Nalegaon	149	1
27.	Jai Bhavani SSK Ltd.			2

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28.	Kada SSK Ltd.	Kada	72	1	53.	Shri Shankar SSK Ltd.	Sadashiv-nagar	274	1
29.	Karmaveer Kaka saheb Wagh SSK Ltd.	Kakasaheb Nagar	360	1	54.	Shetkari SSK Ltd.	Sangli	364	3
30.	Kopargaon SSK Ltd.	Gautam Nagar	217	1	55.	Shirpur SSK Ltd.	Shivaji-nagar	249	1
31.	Krishna SSK Ltd.	Rethare Bk.	368	3	56.	Shri Siddheshwar SSK Ltd.	Manik-nagar	161	1
32.	Kumbhi Kasari SSK Ltd.	Kuditre	250	1	57.	The Siddheshwar SSK Ltd.	Solapur	47	4
33.	Shri Madhi Vibhag K. U. M. Ltd.	Madhi	211	1	58.	Shriram SSK Ltd.	Phaltan	55	4
34.	Madhukar SSK Ltd.	Nhavi Marg	362	3	59.	Shri Someshwar SSK Ltd.	Someshwar-nagar	132	1
35.	Shri Mahankali SSK Ltd.	Rajaram-bapunagar	131	1	60.	Thiru Arooran Sugars Ltd.	Vadapathi-mangalam	234	4
36.	The Maharashtra Sugar Mills Ltd.	Tilaknagar	26	4	61.	The Ugar Sugar Works Ltd.	Ugarkhurd	254	1
37.	The Malegaon SSK Ltd.	Malegaon Bk.	186	3	62.	Shree Warana SSK Ltd.	Warna-nagar	361	3
38.	Manganga SSK Ltd.	Atpadi	67	4	Boiler & Boilers Components				
39.	Mula SSK Ltd.	Sonai	366	3	1.	Allied Alloy Products	Yamuna-nagar	162	3
40.	The Nandyal Coop. Sugars Ltd.	Ayyalur Metta	257	1	2.	A. V. U. Engg. Co.	Hyderabad	161	3
41.	Niphad SSK Ltd.	Bhausahab-nagar	360	3	3.	Bharat General Trading	Delhi	166	3
42.	Punjab Khand Udyog	Zira	356	3	4.	Isgec John Thompson	Calcutta	163	3
43.	Rajarambapu Patil SSK Ltd.	Rajaram-nagar	218	1	5.	J. N. Marshall	Poona	164	3
44.	Sahyadri SSK Ltd.	Yeshwant-nagar	174	1	6.	Kumar Mill Tools	Delhi	168	3
45.	Sahakar Maharshi Shankarrao Mohite SSK Ltd.	Shankar-nagar	284	1	7.	Kokran Boiler Co. Pvt. Ltd.	Bombay	168	3
46.	Sakthi Sugars		154	3	8.	Lipi Boilers	Poona	167	3
47.	Sangamner Bhag SSK Ltd.	Amrut-nagar	363	3	9.	New Ball Bearing Co.	Poona	165	3
48.	Samartha SSK Ltd.	Ankush-nagar	32	4	10.	Powermaster Engg.	Bombay	168	3
49.	Sarayya Sugar Mills Ltd.	Sardar-nagar	54	4	11.	R. C. Industrial Corp.	Bombay	169	3
50.	The Saswad Mali Sugar Factory Ltd.	Malinagar	188	1	12.	R. S. Engg. Works	Bombay	168	3
51.	Satara SSK Ltd.	Bhuinj	83	4	13.	Systems Engg. Corp.	Poona	170	3
52.	Shri Satpuda Tapi Parisar SSK Ltd.	Purushottam nagar	212	1	14.	Tiwari Thermal	Calcutta	171	3
					15.	Tubeweld Engg. Works	Bombay	171	3
					16.	Tube Investments of India Ltd.	Madras	172	3
Agricultural Implements & Irrigation									
					1.	Bajaj Electricals	Poona	139	3
					2.	Diwane Industries	Poona	139	3

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3.	Ecoline Devp.	Poona	140	3
4.	EPC Irrigation	Bombay	140	3
5.	Escorts	Faridabad	141	3
6.	Escorts	Faridabad	157	3
7.	Essey Engineers	Nasik	142	3
8.	Essey Engg. Co.	Nasik	159	3
9.	E. I. D. Parry (I) Ltd.	Madras	156	3
10.	Hymatic	New Delhi	142	3
11.	Indo-Farm Agro Ind.	Ahmed-nagar	143	3
12.	Jindal Aluminium	Bangalore	145	3
13.	Shri Guru Nanak Engg. Co.	Ghaziabad	148	3
14.	Kelga Techno Sales	Poona	153	3
15.	Krishi Utpanna Bazar Samiti	Poona	158	4
16.	Shri Krishna Engg. Works	Kolhapur	148	3
17.	Nitin Agro Engrs.	Poona	144	3
18.	Oriental Engrs.	Delhi	147	3
19.	Pravara Motors	Shrirampur	155	3
20.	Premier Irrigation	Poona	146	3
21.	Power Steel Works		365	3
22.	Raja Tractors	Jalgaon	149	3
23.	Remco Engg. Works	Thane	147	3
24.	Shrikant Agency	A'nagar	151	3
25.	Swami Samarth	A'nagar	142	3
26.	Swstik Industries	Poona	150	3
27.	Trio Engrs.	Poona	152	3
28.	Talreja Engg. Corpn.	Bombay	148	3
29.	Yad Auto Venture	Poona	371	3

Bearings

1.	Austin	Gujrat	160	3
2.	Bearing Centre	Bombay	3	1
3.	Dilip Enterprises	Bombay	372	3
4.	Shri Mahesh Bearing	Calcutta	160	3

Cane Cutting Knives

1.	Luna Agro Ind.	Satara	174	3
2.	Rocket Laboratories	Karad	174	3

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Carbon & Copper Carbon Brushes

1.	Helium Products	Poona	175	3
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Castings

1.	Atul Electroformers	Poona	181	3
2.	B. R. Castings	Yamuna-nagar	176	3
3.	Metal Casting Works	Calcutta	178	3
4.	National Castings	Calcutta	179	3
5.	Nisako Photo	Satara	180	3
6.	Sadhana Foundry	Ghaziabad	177	3

Centrifugal Liners

1.	Tungare Centrifuge Services	Poona		
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Construction Material

1.	Ashok Kale & Associates	A'nagar	204	3
2.	Damodar Ropeways & Construction Co. P. Ltd.	Bangalore	204	3
3.	Gangadhare & Sons	Kolhapur	205	3
4.	Mars Constructions	Bombay	204	3
5.	M. S. Nasik	Poona	204	3
6.	N. S. Bankar Patil & Co.	A'nagar	206	3
7.	Rajashree Cement		206	3
8.	Southern Asbestos Cement Co.	Madras	207	3
9.	Vikram Construction	A'nagar	206	3

Cooling Towers

1.	Suyog Packwell	Sangli	200	3
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Copper & Steel Tubes

1.	Metal Tube & Rolling Mills	Bombay	203	3
2.	Multimetals Ltd.	Bombay	202	2

Fire Fighting Equipments

1.	Prompt Fire Engrs.	Poona	252	3
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Chemicals

1.	Aman Chemicals	Bombay	184	3
2.	Aparna Chemical Ind.	Bombay	185	3

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3.	Aquapharm Chemical Co. Pvt. Ltd.	Pune	193	3	6.	Mapax Industrial Corpn.	Calcutta	213	3
4.	BASF India Ltd.	Bombay	187	3	7.	Nu-Tech Engg. Corpn.		212	3
5.	Chemical Centre	Delhi	188	3	8.	R. N. Nundy & Co.	Calcutta	212	3
6.	Chemical Consultants & Engr.	A'nagar	194	3	9.	Sampats' Engg. Services	Sangli	214	3
7.	Chemofarbe Ind.	Bombay	184	3	10.	Sanatan Iron & Steel		212	3
8.	Dharam Chemicals	Bombay	196	3	11.	Sehgal Sons	New Delhi	214	3
9.	Doshi Industries	Bombay	190	3	12.	Sehgal Sons Engrs.	U. P.	215	3
10.	Hoechst India Ltd.	Bombay	189	3	13.	Swati Metal	Sangli	217	3
11.	J. Alan & Co.	Poona	184	3	14.	Tatya Engg. Works	Sangli	216	3
12.	Kaushal Aromatic	Bombay	190	3	Electricals				
13.	Kemo Industries	Jalgaon	190	3	1.	Aggarwal Electronics	Delhi	223	3
14.	Manikant Brothers	Bombay	371	3	2.	Anita Chemical Corpn.	Bombay	228	3
15.	Navin Fluorine	Bombay	195	3	3.	Asiatic Elect. Corpn.	Bombay	223	3
16.	Orbond Chemicals	Bombay	191	3	4.	Atlas Electricals	Bombay	223	3
17.	Petrosil Products	Poona	191	3	4.	Auto Controls	Satara	367	3
18.	Polychem Ind.	Rohtak	191	3	6.	Bharat Bijlee	Bombay	225	3
19.	Rajit Chemicals	Poona	197	3	7.	Brush Electric	A'nagar	224	3
20.	Rajukesh Inds.	Kanpur	192	3	8.	Desai Electricals	Bombay	226	3
21.	Silepo Chemicals	Poona	197	3	9.	Electra (India)	Bombay	226	3
22.	Solar Chemicals	Poona	197	3	10.	Gandhi Group of Enterprises	Poona	227	3
23.	S. V. S. Chemicals Corpn.	Poona	367	3	11.	Jaivic Electro-Mech. Engg. Pvt. Ltd.	Bombay	233	3
Diesel Generating Sets					12.	Kiran Electricals	Bombay	228	3
1.	Greaves Cotton	Bombay	219	3	13.	Kirloskar Electrodyne	Poona	227	3
2.	Vijay Power Generators Pvt. Ltd.	New Delhi	220	3	14.	Mahalaxmi Light House	Kolhapur	226	3
Gunny Bags					15.	Maruti Electricals	Bombay	231	3
1.	Shree Mahalaxmi Gunny Bag Supply Co.	Bombay	253	3	16.	Mazko Elec. Contractors	Poona	231	3
2.	Swaroop Mechanical Works	Ludhiana	355	3	17.	Metro Light	Poona	229/230	3
3.	Tyco Velcox	Calcutta	373	3	18.	M. S. E. B.	Bombay	231	3
Chains/Sprockets & Clutches					19.	Parag Corporation	Bombay	231	3
1.	Anjali Engg. Corpn.	Bombay	209	3	20.	Prabhat Elec. Corpn.	Bombay	232	3
2.	Arun Engg. Works	Kolhapur	210	3	21.	Shreetron	Thane	232	3
3.	Diamond Chain Ltd.	Madras	211	3	22.	Stanley Switchgear Products	Bombay	233	3
4.	Deekay Industries	Bombay	210	3	23.	Suprabhat Elec. Co.	New Delhi	233	3
5.	Gore & Sons	Sangli	210	3	24.	Versatrip Circuit Breakers Mfg. Co. P. Ltd.	Bombay	235	3
					Electronics				
					1.	Lacchman Electronics	New Delhi	221	3
					2.	Kars Electronics	Poona	365	3

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Erectors & Fabricators					2.	Ashoka Machine Tools	New Delhi	285	3
1.	Aruna Fabricators & Erectors	Kolhapur	238	3	3.	Dilip Sales Corpn.	Poona	284	3
2.	Bright Engrs. & Structures	Poona	239	3	4.	Ghaziabad Machine Tools	Ghaziabad	283	3
3.	Fabrocrafts	Baramati	239	3	5.	Hemkund Engg.	Bangalore	287	3
4.	Gandhi Engrs.	Bombay	239	3	6.	Machine Tools Traders	Bangalore	283	3
5.	Ravi Engg. Works	Poona	240	3	7.	Max Corpn.	Ghaziabad	286	3
6.	Sai Engineering	A'nagar	240	3	8.	P. B. Shah & Co.	Madras	287	3
7.	Uni-Erectors Pvt. Ltd.	Poona	241	3	Hardware Asbestos				
Fertilizers & Pesticides					1.	Anabond	Madras	262	3
1.	Arvee Electricals	Poona	246	3	2.	Arco Ind. Corpn.	Bombay	263	3
2.	Devidayal Agrochem	Bombay	244	3	3.	Asiatic Steel Spring	Poona	263	3
3.	Growell Agrochem	Thane	244	3	4.	Atul Technocrats	Poona	263	3
4.	Inventa Corpn.	Bombay	247	3	5.	Atul Asbestos & Jointing	Bombay	264	3
5.	IFFCO	New Delhi	374	3	6.	Banda Enterprises	Poona	264	3
6.	Krishak Bharati Coop. Ltd.	New Delhi	248	3	7.	Bharat Asbestos & Rubber Co.	Bombay	265	3
7.	MAIDC	Bombay	249	3	8.	Bharat Indl. Corpn.	Bombay	273	3
8.	Ranadey Micronutrients	Poona	251	3	9.	Bonduct Processors	Poona	266	3
Gears					10.	Bombay Machinery Stores	Bombay	264	3
1.	Flender Macneill Gears Ltd.	Calcutta	255	3	11.	Budhale & Budhale	Kolhapur	266	3
2.	Gears (India)	Ghaziabad	259	3	12.	D. R. N. Enterprises	Bombay	266	3
3.	Greaves Cotton & Co. Ltd.	Bombay	256	3	13.	Elevation Ladder Mfg. Ind.	Bombay	267	3
4.	Hindustan Gears	Satara	254	3	14.	Hardtools	Madras	267	3
5.	Krishna Engg. Works	Delhi	261	3	15.	Industrial Engineers	Bombay	267	3
6.	Laxmi Metal	Ghaziabad	254	3	16.	Jain Wire	Bangalore	268	3
7.	Nav Bharat Engg. Works	Ghaziabad	260	3	17.	Jamshedpur Asbestos & Mfg. Co.	Calcutta	268	3
7.	New Allenberry Works	Calcutta	257	3	18.	Juzer Sales	Madras	272	3
Instrumentation					19.	K. S. Nagori	Poona	269	3
1.	Eureka Ind.	Poona	279	3	20.	Lalani Inds.	Mazgaon	269	3
2.	Mahindra & Mahindra	Calcutta	277	3	21.	Milan Fabricators	Bombay	270	3
3.	Minilec Protecto Relays	Poona	279	3	22.	Milind Commercial Corpn.	Bombay	270	3
4.	Minilec Protective	Poona	281	3	23.	Ramji Lal Ram Saroop	Delhi	271	3
5.	Vacuum Plant Instru.	Poona	280	3	24.	Shah Trading Co.	Ahmedabad	270	3
6.	Scientific Instrument Co. Ltd.	Allahabad	273	3	25.	Sona Engg. Stores	Bombay	273	3
Machine Tools & Tackles					26.	Surendra Trading Co.	Bombay	273	3
1.	Ajax Engg.	Bangalore	283	3	27.	Universal Hardware Mart	Madras	274	3

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Paints									
1.	Densons Engineers	New Delhi	289	3	6.	Digvijay Tiles	Bombay	313	3
2.	Texachem Products	Poona	290	3	7.	Everest Refractories	Faridabad	315	3
PVC Pipes & Fittings					8.	Flexojoint Belt Ind.	Bombay	318	3
1.	Finolex Pipes	Poona	291	3	9.	Kiran Enterprises	Bombay	321	3
2.	Jain Group	Jalgaon	292	3	10.	Lilanand Machinery & Hardware Agencies	Porbandar	314	3
3.	Moss Plastics	Nasik	295	3	11.	Mag Hard Insulators	Bombay	314	3
4.	Shivalik Agro-Poly Products	Delhi	296	3	12.	Nipa Rubber	Nasik	320	3
5.	Supreme Pipes	Chandigarh	294	3	13.	Patco	Sangli	319	3
6.	Varsha Agro Plast P. Ltd.	Poona	293	3	14.	Southern Engg.	Madras	317	3
Pumps					15.	Thermochem	Poona	317	3
1.	Airauto Engg. Co.	Bombay	299	3	Weighing Scales				
2.	Bajaj Electricals Ltd.		298	3	1.	Accurate Weighing Machines Co.	Bombay	340	3
3.	Best & Crompton	Madras	301	3	2.	Shri Ambika Scales Mfg. Works	Gujarat	342	3
4.	Calama Inds.	Bombay	299	3	3.	Avery Scales	Poona	341	3
5.	Chemineers	Rajkot	300	3	4.	Avon Scales Corp.	New Delhi	342	3
6.	Concord Marketings	Bangalore	308	3	5.	Bharati Scales & Engg. Co.	Howrah	344	3
7.	Gita Pumps	Saharanpur	302	3	6.	Giri Brothers	Madras	343	3
8.	Greaves Cotton	Bombay	300	3	Tarpaulins				
9.	Hi-Tech Enterprises		372	3	1.	Bhagade & Co.	Poona	327	
10.	Kakati Krashak	Hyderabad	303	3	2.	Dwarkadas Velji Tadpatriwala	Bombay	327	3
11.	KSB Pumps	Poona	305	3	3.	Premier Tarpaulins	Coimbatore	327	3
12.	La Gajjar Blowers	Poona	304	3	4.	Swastik Tarpaulins	Bombay	328	3
13.	Max Corporation	Ghaziabad	306	3	Seamless Tubes				
14.	Maxflow Pumps P. Ltd.		311	3	1.	Amar Tube Corp.	Bombay	322	3
15.	Nagpal Harkrishna Lal	Delhi	304	3	2.	Indian Aluminium Co. Ltd.	Kerala	323	3
16.	Pumps India	Kanpur	310	3	3.	Neeka Tubes	Ahmedabad	324	3
17.	Rohini Engg. Works	Sangli	304	3	4.	Premier Tube & Hardware Mart	Bombay	325	3
18.	Ruso Agro Engg.	Poona	310	3	Transporters				
19.	Shri Industries	Sangli	307	3	1.	Ashok Leyland	Madras	329	3
20.	WASP - Water Supply Specialists Pvt. Ltd.	Bombay	309	3	2.	Enfield India Ltd.	Madras	330	3
Refractories					3.	Expo Machinery	Bombay	332	3
1.	Ark Thermal Insulation	Poona	313	3	4.	M. Nusserwanji & Co.	Poona	333	3
2.	Atul Rubber Products	Nasik	320	3	5.	Penosh Transporters	Poona	331	3
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4.	Conveyor Systems	Bombay	318	3					
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DEVELOPMENT OF INDIAN SUGAR INDUSTRY - HISTORICAL

P.J. MANOHAR RAO

India is reputed to be the country of origin of sugarcane; reference to "Sweet Grass"-Sugarcane-exists in ancient epics of India dating 3000 BC. North-Eastern India was regarded as the centre of origin, from where sugarcane seems to have carried to China by early travellers and nomads, sometime between 1800 and 1700 BC. Later, it spread to Philippines, Jawa and other places including Carribean islands by explorers and so was established the growth of sugarcane in many countries. Production of sweetening materials like sugar from sugarcane, is the greatest contribution that India and China have gifted to the world. Sugar is referred to as Sharkara in Sanskrit. Chini is another word for sugar derived from China in which country the manufacture of sugar in different food forms, was originally practised.

1.2 India, the mother country of sugarcane, occupies even today a place of pride in the world. India is the foremost among the sugarcane producing countries in the world (Fig.1); it produces annually about 180 million tonnes of cane. This is utilised for production of different sweetening agents including crystal sugar, which alone forms the base for world's sugar statistics. From the stage of production of less than 0.1 million tonnes of crystal sugar in early 1930's, India has become the largest crystal sugar producing country in the world, reaching 8.4 millions tonnes of production in 1981-82.

1.3 The commendable achievement of Indian sugar

industry over the last 5 decades is due to careful planning and development by the Central and State Governments and by all concerned with sugar industry. This Chapter presents an account of the historical development of the Indian sugar industry.

2. General

2.1 The sub-continent, India, being situated in tropical and sub-tropical areas is ideally suited for sugarcane cultivation. Nearly one-third of the soil in the genetic plains in the North is alluvial, with vast stretches of red soils in the Deccan belt, etc. The climate is of tropical monsoon type. The sub-tropical region experiences monsoon in June to September and also in the winter months, January and February. The tropical region has rains both by the south-west and south-east monsoons in May-September and in October-December. The mighty rivers, the Ganga and the Yamuna in the northern India, and the Godavari, Krishna and Cauvery in the South, provide adequate irrigation facilities. Irrigation is also supplemented by supplies from tanks and wells. The total irrigated area in India is about 40 million hectares, as against 175 million hectares of cropped area. Sugarcane occupies about 2.5% of the total cropped area in India. Sugarcane is grown in almost all parts of India except in the colder regions of the extreme North like Jammu and Kashmir, Himachal Pradesh etc. (See Fig.2)

*Shri Manohar Rao is B.Sc. (Hons) in Chemical Technology from the Andhra University, Waltair with specialisation in Sugar Technology. He acquired practical experience for six years in different sugar factories and then joined Government on India service in 1956. Since then he has worked in various responsible capacities in the Government including the Directorate of Sugar. He has also served on many committees/commissions constituted by States as well as Central Governments on the different aspects of Sugar Industry.

He has contributed many technical articles, some of which are awarded winners and have been published in leading international sugar journals. He represented Government of India at the ISSCT in Brazil 1977; in Philippines in 1980, and in Cuba, 1983, he also submitted papers at Jakarta ISSCT Conference in 1986.

After working as Additional Chief Director of Sugar, he is now the Managing Director of National Federation of Cooperative Sugar Factories Ltd., New Delhi.

The World Map of Sugar Industry



Fig. - 1

- 1) Antigua, 2) Argentina, 3) Barbados, 4) Brazil, 5) Cuba, 6) Dominion Republic, 7) Bangala Desh
 8) Egypt, 9) Fiji, 10) Florida, 11) Formosa, 12) Guana, 13) Hawaii, 14) India, 15) Indonesia,
 16) Jamaica, 17) Louisiana, 18) Mauritius, 19) Mexico, 20) Natal, 21) Peru, 22) Philippines,
 23) Puerto Rico, 24) Queensland.

SRI CHAMUNDESWARI SUGARS LIMITED

Regd. Office :

37/1, Ulsoor Road,
 BANGALORE 560 042

Tel: 577033/577034

Gram: CHAMSUGAR

Telex: 0845-508 SCS IN

Factory:

K.M. Doddi,
 Maddur Taluka

Mandya Dist.

Pin 571 422

Tel: 404 (Mandya)

Shri N. Mahalingam (Chairman)
 Shri V. Venkata Reddy (Managing Director)
 Shri A. Alagappan (Commercial Director)
 Shri K. S. Srinivasan (General Manager)

Crushing Capacity : 2400 TCD

One of the modern and progressive sugar mills in Karnataka

3. Hybrid Varieties of Cane :

Commercial Cultivation

3.1 The varieties of cane being grown from centuries in India have been of *sachharum officinarum* type which are also referred to as noble or garden canes; though these have high sugar content, they are highly susceptible to diseases because of the soft nature of the rind; they are prone to attack by jackals and other animals. However, the soft canes have not been found suitable for efficient milling operations. The development of hybrid varieties, by crossing *saccharum officinarum* varieties with wild plants like *saccharum robustum*, etc. in early 1920's by late Sir T. S. Venkatraman and his colleagues at the Sugarcane Breeding Institute, Coimbatore, led to a revolution in the sugarcane cultivation as well as in the sugar industry. The hybrid varieties were less prone to

diseases and to attack by animals. The crop became an assured source of sustenance and enabled the farmer to grow the same on commercial scale. Because of their hard rind nature, the hybrid varieties facilitated efficient milling operations. Because of this important property, the hybrid varieties developed at Coimbatore, known as 'Co' varieties have led to establishment of sugar industry on a firm basis not only in India but also in many countries of the world. The following gives an account of 'Co' varieties of sugarcane being cultivated even today in other countries :

- (a) Egypt - Co 413
- (b) Sudan - Co 281, Co 453, Co 527
- (c) Malawi - Co 617, Co 622
- (d) Zimbabwe - Co 421, Co 462
- (e) Nigeria - Co 957, Co 1001
- (f) Thailand - Co 281, Co 419, Co 421
- (g) Brazil - Co 331, Co 419, Co 421, Co 740, Co 775

State-wise Yield of Sugarcane in India

State	(Tonnes/hectare)					
	80-81	81-82	82-83	83-84	84-85	85-86
1. Andhra Pradesh	75.9	83.3	74.3	68.9	71.1	72.6
2. Andaman & Nicobar Islands	3.0	3.0	13.0	4.0	5.0	5.0
3. Assam	35.8	43.6	42.0	43.9	50.7	41.2
4. Bihar	28.2	33.8	34.2	30.4	33.4	33.1
5. Delhi	1.5	1.0	0.5	1.0	-	-
6. Gujarat	59.2	59.6	70.3	75.5	73.4	71.5
7. Haryana	40.5	39.7	37.4	44.3	41.9	48.6
8. Himachal Pradesh	15.7	14.4	9.3	15.6	14.2	11.2
9. Jammu & Kashmir	37.1	28.5	27.6	32.6	34.4	30.2
10. Karnataka	79.4	81.5	79.7	74.2	77.9	78.4
11. Kerala	59.3	59.9	59.4	NA	54.8	54.1
12. Madhya Pradesh	27.4	28.4	28.7	33.1	32.6	32.3
13. Maharashtra	92.3	96.9	96.3	90.3	90.1	89.4
14. Manipur	33.0	33.9	35.3	35.3	35.3	35.3
15. Meghalaya	46.5	45.0	45.0	56.0	36.0	36.0
16. Mizoram	4.6	4.6	4.6	5.0	3.5	3.5
17. Nagaland	29.9	31.8	37.0	30.0	27.0	30.0
18. Orissa	63.0	64.4	61.9	67.7	64.9	64.9
19. Punjab	55.2	57.7	61.0	65.8	62.5	64.7
20. Pondichery	76.5	83.5	86.1	59.3	67.9	67.4
21. Goa, Daman & Diu	48.4	49.8	42.7	44.5	49.9	42.0
22. Rajasthan	39.5	38.7	37.5	44.2	40.5	38.1
23. Tamil Nadu	101.5	100.4	87.2	87.4	103.8	108.0
24. Tripura	38.2	39.6	40.0	37.9	36.4	36.1
25. Uttar Pradesh	47.1	46.3	45.7	46.4	45.9	49.0
26. West Bengal	60.7	61.3	51.4	50.4	57.5	63.0
ALL INDIA	57.8	58.4	56.4	56.00	57.8	60.00

Map of Sugar Industry in India

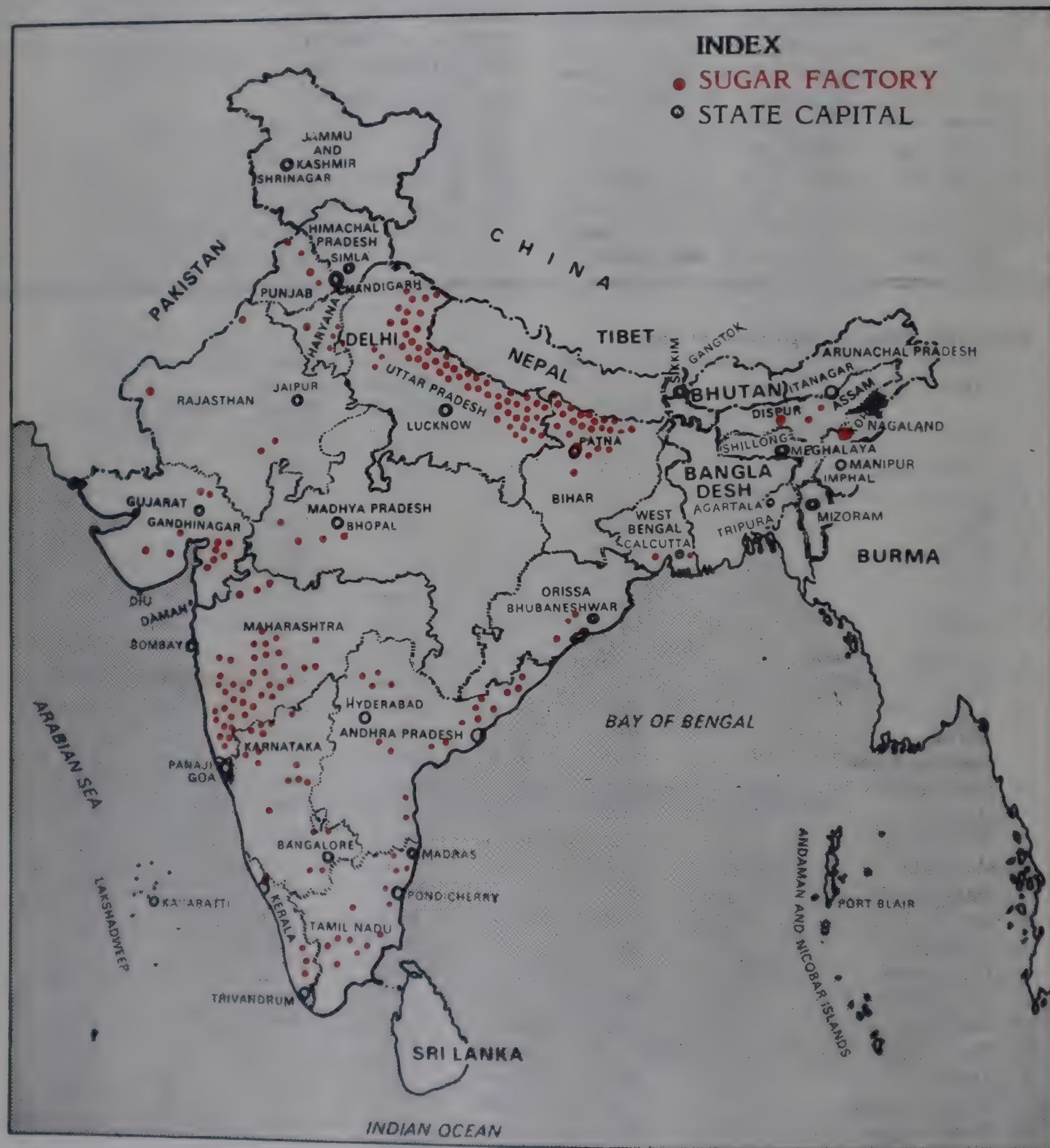


Fig. - 2

- (h) Burma - Co 419
- (i) Argentina - Co 290, Co 421
- (j) Sri Lanka - Co 527
- (k) Mexico - Co 213, Co 290
- (l) Morocco - Co 290
- (m) Mozambique - Co 421
- (n) Pakistan - Co 312, Co 313
- (o) Bangladesh - Co 421, Co 453
- (p) Uganda - Co 421
- (q) Venezuela - Co 421

3.2 Differences in agro-climatic and environmental conditions prevailing in different parts necessitated developing various varieties of cane suitable for successful commercial cultivation. Cane to be used as raw material for an industry, required sustained efforts to breed continuously high yielding and disease-resistant varieties suitable for different climatic conditions and compelled availability of the right seed in large quantities for commercial cultivation, similarly, it was necessary to develop cultural practices suitable for each variety. For this purpose, the Central and State Governments have established various sugarcane research centres, the details of the same are dealt with in a subsequent chapter.

3.4 The Indian Institute of Sugarcane Research, Lucknow makes a detailed study on the cultural practices required to be adopted for each sugarcane variety; pathological and entomological and studies relating to varieties are also undertaken.

3.5 When a variety is proved to be commercially viable and is ready for release for cultivation by cane growers at large, recommendations are made to the concerned State Governments for propagation of a variety or varieties. After the State Government's approval, the recommended variety is grown in the farms attached to the State research stations or centres in adequate quantity. Cane sets or seeds of a proved variety are issued to a sugar factory area/zone for primary and secondary seed cultivation and finally for commercial cultivation by farmers.

3.6 It is noteworthy to point out that the time involved in sustained research for breeding and development of a variety of cane and its release for commercial cultivation is about 10 to 12 years. It requires considerable amount of financial input and devoted and concerted research for evolving a variety. If the released variety is not well maintained by adopting good cultural practices, the potential of the variety decreases; it becomes susceptible to diseases; the yields decrease and the farmers lose interest in it and look for another variety. The varietal deterioration which occurs primarily by not adopting the recommended

cultural practices, is the bane of Indian Sugarcane cultivation and becomes a drain on the finances to be invested in breeding of varieties. Efforts are being made by Central and State Governments, research stations, factory organisations and others, to propagate adequate measures for varietal maintenance.

3.7 It may be noted that for developing new varieties, canes of different species have to be maintained for crossing purposes and for obtaining fluff (seed) etc. at different times. Sugarcane scientists all over the world felt that collection of the original canes of different varieties which have played an important part in sugarcane agriculture should be maintained atleast in two countries in the World-one, in the Eastern hemisphere and the other in the Western hemisphere. Accordingly, the Sugarcane Research Station, Canal Point, Florida, U. S. A. and the Sugarcane Breeding Institute, Coimbatore, were chosen as the centres for preservation of all the sugarcane progenies by the International Society of Sugarcane Technologists at its Congress held in Barbados in 1953. Later, the world sugarcane collection centres was shifted from Coimbatore to Cannanore, Kerala, where it now is. The main objectives of the Cannanore Centre are -

- (a) Collection and maintenance of original sugarcane in a live herbarium, establishing breeding stock, sugarcane clones of special botanical and cytogenetical interest, rare hybrids, important commercial varieties selected with wild sugarcane from various countries.
- (b) Identification and standardization of sugarcane varieties.
- (c) Compilation of catalogue of sugarcane genetic stocks.
- (d) Supply of clonal material of breeding stocks to other countries, and
- (e) Pooling and dissemination of knowledge of the world collection of sugarcane.

There are more than 25,000 varieties of sugarcane collected and maintained by clonal propagation every year; of these, about 600 belong to *saccharum officinarum* type, which flower well and are used for crossing purposes.

3.8 The Institute at Coimbatore in collaboration with the Cannanore centre and other sugarcane research centres of different States, has developed as many as 1925 new varieties of sugarcane. It is gratifying to point out that some of the varieties have revolutionised the sugar industry particularly in some States of India in the recent past. For example, the Co 1148 and Co 1158, released about 2 decades back in the

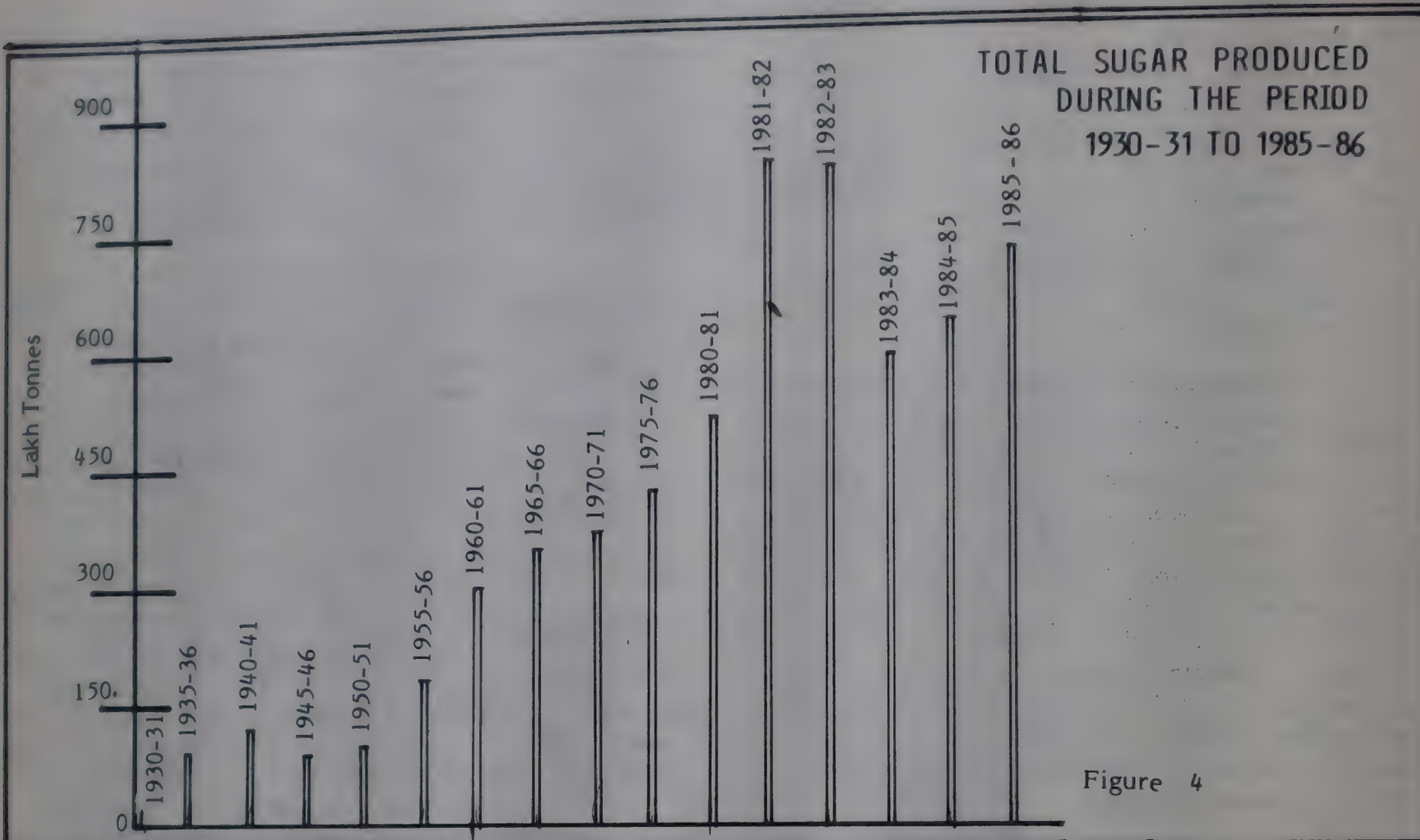


Figure 4

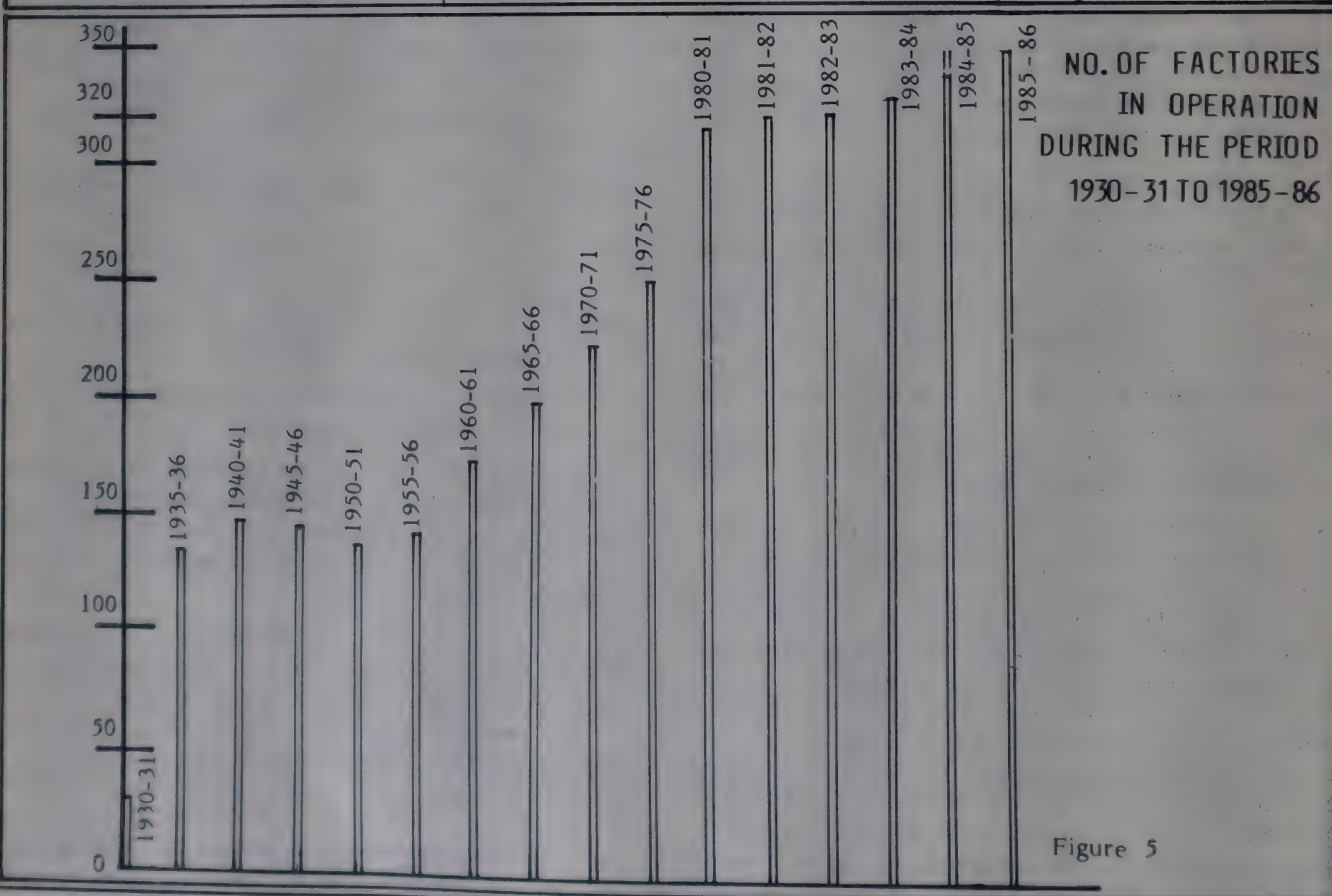


Figure 5

Eastern and Central U. P., have resulted in sugar factories in these areas recording very high recoveries and thus improving their performance. Punjab and Haryana have earlier been branded as the States where establishment of Sugar Industry would be of no avail, recoveries being as low as 8 to 9 and cost of production high. But release of CoJ64, about two decades back, the face of Sugar Industry has been completely changed; recovery improving to 9.5. Similarly, Tamilnadu benefitted immensely by Co 679 variety.

3.9 The list of varieties grown commercially in different States of India is given below :

States	Varieties
Uttar Pradesh	Co 1148, Co 1158, B.O.17, B.O. 54, B.O. 70
Maharashtra	Co 740, Co 419, Co 775
Haryana	Co 1148, Co 975, Co 1158
Tamil Nadu	Co 419, Co 658, Co 6304, Co 449, Co 740, Co 6806, Co 853
Andhra Pradesh	Co 419, Co 997, Co 62175
Bihar	B.O.14, B.O.17, B.O.70, B.O.34, B. O.29, Co 1158, B.O. 32, B.O.3, B.O.43, B.O.72
Karnataka	Co 419, Co 740, Co 449
Punjab	Co 1148, CoJ 46, Co 1158, CoJ 64, Co 975, CoJ 58, CoJ 67
Madhya Pradesh	Co 419, Co 954, Co 678, Co 312, Co 421, Co 853, Co 1307, Co 290, Co 617, Co 313
Orissa	Co 419, Co 997, Co 881, Co 740, Co 527, Co 62175, Co 1053
Orissa	Co 419, Co 997, Co 881, Co 740, Co 527, Co 62175, Co 1053
Assam	Co 740, Co 313, Co 997, Co 961
Rajasthan	Co 419, Co 312, Co 1111, Co 1253, Co 449, Co 1007, Co 527, CoL 29
Gujarat	Co 419, Co 775
West Bengal	Co 527, Co 62010, Co 1008, B.O.17, Co 419, Co 1132, Co 1232
Kerala	Co 997, Co 449, Co 419, Co 785, Co 349, Co 740
Nagaland	Co 419, Co 740, Co 421
Pondichery	Co 658, Co 6304, Co 853

4. Statistics on Sugarcane Cultivation in India

4.1 The Directorate of Economics and Statistics, Ministry of Agriculture, New Delhi, is the primary organisation which attempts collection of all the statistical information regarding cane cultivation in different States of India. This Directorate is assisted by another Central Government organisation, namely the Directorate of Sugarcane Development; various other Departments of Agriculture of State Governments also help in obtaining information on cane cultivation. The statistical data collected by these organisations are submitted annually to the Sugarcane Development Council constituted by Government of India under the provisions of Industrial Development & Regulation Act, 1951 (vide infra). These data are of considerable help in planning for over-all development of sugarcane cultivation and sugar industry which forms part of the Five-Year Plan programmes of the country.

4.2 Fig. 3 gives the data on the area-wise acreage under cane, yields per hectare and total production of sugarcane in the country over the last 5 decades, i. e. from 1930-31 to 1985-86. It may be noted that the area under cane increased from about 1.16 million hectares in 1930-31 to 2.28 million hectares in 1960-61; it was 2.46 million hectares in 1970-71 and 2.66 million hectares, in 1980-81. It was maximum, 2.89 million hectares, in 1974-75 and later, reached a record high figure of 3.35 million hectares in 1982-83. In 1985-86 the area was 2.86 million hectares.

4.3 The sugarcane yields in India are in the range of 30-60 tonnes per hectare. The yields are continuously on increase; but the increase is, however, not marked. It may be pointed that the sugarcane yields remain low in the sub-tropical region, the reasons being primarily low standard of cultivation, adverse agro-climatic condition restricting the effective growth period to 6-7 months only in a year. The yields are, however, appreciable in the tropical region, particularly in Maharashtra and Tamil Nadu. (see Table 1). In Maharashtra the yields range from 78 to 97 tonnes per hectare, and in Tamil Nadu, the same are in the range of 91-105.

4.4 It is a matter of pride that the total production of sugarcane in India had achieved remarkable progress. From 36 million tonnes in 1930-31, the same increased, over the last 5 decades, to 186 million tonnes. As stated earlier, India's total production of sugarcane is the highest in the world.

4.5 Analysis of the results in Fig. 3 indicates an interesting phenomenon : the increase in the area under cane and the total production of sugarcane are not progressively and continuously increasing. There

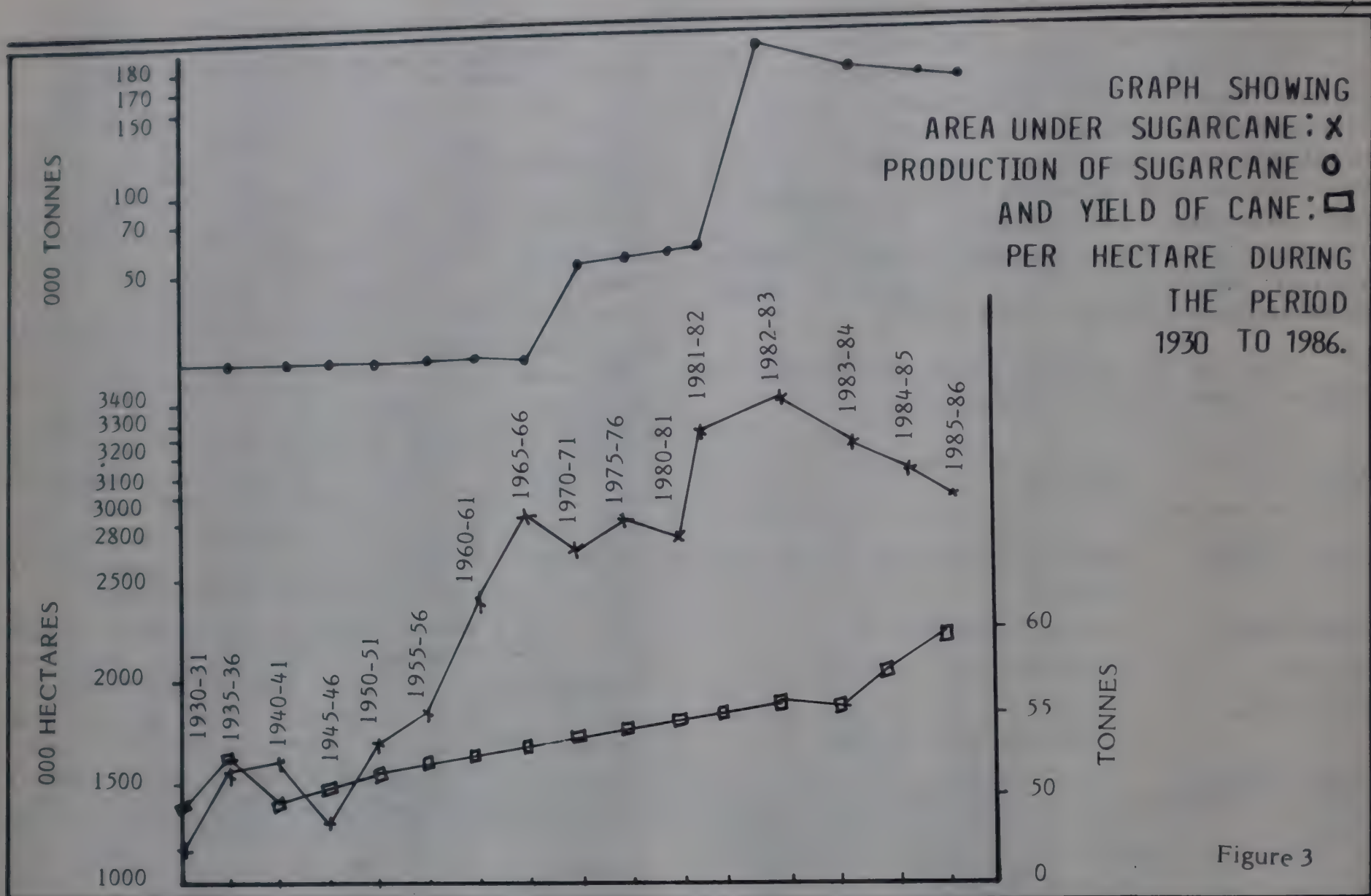


Figure 3

Ajinkyatara Sahakari Sakhar Karkhana Ltd.

Shahunagar Shendre
Tal. & Dist. Satara

Gram: AJINKSAKAR, Satara

Tel: 3124, 3386 Satara

'Salient Features':

- 'FORT' 'Ajinkyatara' is our inspiration
- A record erection with the minimum possible period of 18 months only and start of its First Crushing Season on 'VIJAYADASHMI' on 4.10.1984.
- Full devotion for the Agricultural, Social and Economical development of whole of the Satara Taluka.
- Full utilisation of bye-products through Distillery, Dairy and Animal Foodstuffs.
- Uplift of backward and Navbuddhas by availment of interest free loan and subsidy and creation of linking of sugarcane cultivation
- First Record Production of 160,000 Sugar Bags during the First Crushing Season 1984-85.

Vikramsinh H. Aparadh
Managing Director

Abhaysingh Rajee Bhosale
Chairman

Board of Directors

are fluctuations. It is interesting to point out that these figures follow a pattern, or 4-year cycle of variation; that is increase occurs for a period of 2 years, followed by a decrease over the next period of 2 years. These variations or fluctuations (see Fig. 4) in cane area and production in the country, have resulted in, at least in some areas, adverse effects on the production of sweetening agents. Particularly crystal sugar, and on the economic development of the cane-grower and the sugar industry. These fluctuations are to some extent due to the changes in the climatic conditions like drought, etc. and are primarily due to significant variations in cane prices received by cane grower. (see Fig. 4)

5. Payment of Cane Prices in India

5.1 Sugarcane price plays an important role in the farmers' decision to increase the area under cane and therefore, on the production of sugarcane. At a farmers' conference convened by Government of India in 1933, representatives of cane growers advocated that a minimum price should be fixed by the Government and the same should be statutorily enforced for payment by sugar factories. The Government accepted this demand and passed in 1934 the sugarcane resolution which conferred powers on the Provincial (State) Governments to fix minimum price for cane. In exercise of these powers, the Government of U. P. and Bihar fixed for the first time in India, the minimum price for cane in 1937-38. They enacted their legislation and fixed the minimum price under the State Act. Other States also fixed the minimum price under the Sugarcane Act, 1934. Minimum price for cane continued to be fixed by State Governments upto 1950-51; the lack of uniformity in the price fixed or the lack of uniformity in either price fixed or the methodology adopted in fixing the same led to unrest among cane growers in the country. At the request of the Government of India, the Tariff Board (1950) examined the issue and suggested that while fixing the minimum price, such factors as cost of cane cultivation and fair return to cane-grower should be taken into consideration. Following the recommendation of the Tariff Board, a provision was made in the Sugar Cane Control Order, 1955 (later replaced by the Sugarcane Order, 1966) which empowered the Central Government to fix the minimum price for the cane having regard to the following :

- (a) Cost of production of sugarcane
- (b) The return to the grower from alternative crops and the trend of prices of agricultural commodities
- (c) The availability of sugar to the consumer at a fair price

- (d) The price at which sugar produced from sugarcane is sold by producers of sugar; and
- (e) The recovery of sugar from sugarcane.

5.2 Of the above, the factory recovery of sugar from sugarcane has a special significance; for long time the demand had been made both by the industry and the cane-growers that the price of cane should be related to its quality. Several attempts had been made to evolve a method to relate the price of cane to its quality. A delegation also went to Australia and Indonesia to study, inter alia, the problem of payment of cane price related to its quality. The National Sugar Institute, Kanpur carried out experiments in 10 factories during the seasons 1956-57 to 1961-62 to evolve a workable scheme for the purpose. In view of the large number (running into thousands) of cane growers supplying small quantities of cane every day to a factory, the problem of estimation of the quality of sugarcane supplied by each individual cane grower becomes almost impracticable and could not be adopted in spite of the recommendations of the Tariff Commission (1961) and the Sen Commission (1965). The Government resolved that the average sugar recovery of a factory during the fixed (optimum) period of the previous season should be related to the formula for fixing the minimum cane price, which is considered as an interim arrangement for collective incentive for improvement in quality of cane to the cane-growers attached to a factory. Since 1962-63, Government price linked to a basic sugar recovery with premium for every 0.1% increase in sugar recovery over the minimum statutory cane price payable by each sugar factory under this formula is guided by the recommendations of Agricultural Prices Commission and the views of the State Government, industry, cane-growers and other interested organisations. The minimum cane price is being fixed with the object of ensuring payment of a guaranteed price for cane by sugar factories to cane-growers.

5.3 Table 2 gives an account of the basic recovery and premium fixed by the Government of India for payment of minimum cane price by sugar factories.

5.4 Based on the above formula, the sugarcane prices payable ranged, say - in 1975-76 from Rs. 8.5 to 12.8, in 1980-81 from 13.00 to Rs. 18.35 per quintal; in 1982-83, the same was from Rs. 13.00 to Rs. 19.12. With significant rise in the prices of inputs in cane cultivation experienced continuously over the last 10-12 years, cane-growers were not satisfied and demanded higher cane price than what is payable on the basis of the above formula. The government of India with a view to hold the price line in general

could not accede to the demand of increase in the minimum cane price, but, advised the State Governments and the industry for payment of higher cane price than the minimum and observed that the payment of minimum cane price shall be reckoned only for the purpose of calculation of the price of levy sugar at which the Government would acquire sugar for public distribution system (vide infra).

5.5 For the last 10 years or so, sugar factories in most of the States have been paying higher than the minimum statutory cane price, on the advice of the State Governments; these have been in some cases, upto Rs.25 per quintal.

5.6 It may be added that in the country, viz. Gujarat and Maharashtra, cane price is paid ex-field. In other words, the factories pay the price for the standing crop; cane is harvested and transported by factories themselves. In other States, cane growers harvest

Table 2
Factor for working out Cane Price
Payable by Factories

Years	Minimum Price (Rs. per Qtl.)	Linked to basic recovery	Premium on every 0.1% increase (Rs. per Qtl.)
1963-64	4.69	9.0	0.04
1964-65	5.36	10.4	0.04
1965-66	5.36	10.4	0.04
1966-67	5.68	9.4	0.04
1967-68	7.37	9.4	0.0536
1968-69	7.37	9.4	0.0536
1969-70	7.37	9.4	0.0536
1970-71	7.37	9.4	0.066
1971-72	7.37	9.4	0.066
1972-73	8.00	8.5	0.094
1973-74	8.00	8.5	0.094
1974-75	8.50	8.5	0.10
1975-76	8.50	8.5	0.10
1976-77	8.50	8.5	0.10
1977-78	8.50	8.5	0.10
1978-79	8.50	8.5	0.117647
1979-80	12.50	8.5	0.147059
1980-81	13.00	8.5	0.1152941
1981-82	13.00	8.5	0.152941
1982-83	13.00	8.5	0.152941
1983-84	13.50	8.5	0.158824
1984-85	14.00	8.5	0.164706
1985-86	16.50	8.5	0.194118
1986-87	17.00	8.5	0.20
1987-88	18.00	8.5	

Table 3
Statewise Quality of Sugarcane

State	Average Sugar %	Average Primary juice purity	Average fibre %
Andhra Pradesh	11.39	81.84	13.91
Assam	11.34	81.17	14.21
Bengal	12.23	83.09	16.46
Gujarat	12.52	81.56	13.86
Haryana	11.02	78.03	15.04
Karnataka	12.98	83.59	13.01
Kerala	10.68	79.78	14.24
Madhya Pradesh	12.23	80.91	14.97
Maharashtra	13.62	86.5	12.9
Orissa	11.3	79.23	14.75
Pondicherry	10.63	81.28	14.98
Punjab	10.61	77.56	15.40
Rajasthan	11.68	78.59	14.52
Tamil Nadu	11.12	79.67	13.92
Uttar Pradesh	12.1	82.0	16.19
West Bengal	11.86	82.5	15.8

Table 4
Utilisation of Cane for Different Purposes

Year	Percentage utilised for		
	Crystal Sugar	Gur and Khandsari	Chewing; Seed etc.
1971-72	27.31	60.79	11.90
1972-73	32.36	55.63	12.01
1973-74	30.04	58.04	11.94
1974-75	33.56	54.52	11.39
1975-76	29.56	58.34	12.04
1976-77	31.98	55.98	12.04
1977-78	38.03	50.07	11.94
1978-79	39.4	48.80	11.80
1979-80	30.5	57.9	11.6
1980-81	33.4	54.8	11.8
1981-82	46.9	41.3	11.85
1982-83	43.7	44.6	11.7
1983-84	33.9	54.0	12.1
1984-85	35.3	52.9	11.8
1985-86	39.9	48.2	11.9

and transport their cane; if situated within a radius of 16 kms. or so, from the factories, cane-growers ordinarily take their cane to the gates of factories by bullock carts or tractor trolleys. A small number carry their cane by trucks and other means of transport. The system of out-station purchasing centres exists in almost all the States of the North and also in the case of some factories in the South. The factory managements arrange transport of the cane purchased at the out-station centres to the factories. Factories are allowed to pay lesser price for cane delivered at the out-station purchasing centres; a deduction of 32 paise per quintal is allowed from the minimum cane price in case the cane is transported by rail and at the rate of 2.5 paise per quintal per km. subject to maximum of 32 paise per quintal, if transported by road.

5.7 The cane price is payable within 14 days from the date of receipt of cane by a factory.

6. Quality of Indian Cane

6.1 The three important properties which determine the quality of cane are : Sugar percentage purity of primary juice and fibre percentage.

6.2 Table 3 gives the State-wise data on these three factors of sugarcane in India.

From these results it may be seen that canes in Maharashtra are the sweetest; the sugar percentage in cane varies from 13 to 14.5. The quality of cane is influenced appreciably by the agroclimatic conditions; in the years of acute drought the fibre percent cane is reported to go even beyond 18%. As mentioned earlier, the average quality of cane in Punjab, Haryana, Uttar Pradesh and Tamil Nadu is improved considerably with the advent of improved varieties of cane.

7. Utilisation of Sugarcane for Different Purposes

7.1 As stated earlier, sugarcane in India is utilised; for production of three sweetening agents : (i) Gur, (ii) Khandsari and (iii) Crystal Sugar. The total quantity of sugarcane produced in the country is fairly accurately assessed annually. The amount of cane crushed in sugar factories, which operate in an organised sector, under licences issued by the Central Government, is accurately known. Approximate figures relating to utilisation of cane for khandsari and gur are assessed by the quantity of these sweetening agents that come into the market. The rest of the cane is deemed to have gone for chewing, seed and other purposes.

7.2 Table 4 shows the utilisation of sugarcane for different purposes :

It is seen that in 1985-86, 39.9% of sugarcane is utilised by sugar factories for production of crystal sugar and about 48.2% for Khandsari and gur.

7.3 Aspects relating to production of Khandsari and gur in India are given in some detail in the following chapter. In what follows in this chapter, an account of the sugar industry producing crystal sugar is given.

8. Development of Indian Sugar Industry

8.1 In the early part of the century, upto 1920's there were a few sugar mills in U. P. and Bihar, set up in areas where sugarcane was being grown traditionally. There were about 30 factories of small capacities producing hardly 1.0 - 1.5 lakh tonnes of sugar in the country. The production of sugar was not sufficient to meet the demand of domestic consumption; so sugar was being imported from Jawa etc. Indian sugar factories were unable to meet the competition of the imported Javanese sugar, which was commanding the Indian market. At the request of the local sugar industry, the case was referred, by the Union Government, to the Tariff Board. Based on the recommendations of the Tariff Board, the Sugar Industry Protection was granted to the indigeneous sugar industry; the Act provided powers by which the Union Government levied duties on imported sugar, so that indigeneous industry could compete and survive.

8.2 This Act was followed by another legislation enabling the Provincial (State) Governments to enforce the minimum price to be paid by sugar factories to cane-growers in respect of the cane supplied by them as per Sugar Cane Act of 1934 (vide supra). These two actions of the Union Government gave significant impetus and encouragement to entrepreneurs to set up sugar factories in various parts of the country. Many of them with a capital of Rs.3-4 lakhs had imported old Javanese sugar factories and set up in different parts of the country. The number of factories operating in India sprung up from 31 in 1931-32 to 111 in 1933-34 and 137 in 1936-37. By 1938-39, the production of sugar in India touched 12.7 lakh tonnes. During the subsequent years, the industry suffered due to various reasons and the output remained between 9-11 lakh tonnes mainly on account of the instability of cane supplies.

8.3 With the advent of the institution of the Five Year Plan Programme for the general national development, the sugar industry too received considerable amount of support. As a part of the programme, the development and regulation of the sugar industry came under the control of Government of India, while before 1952 the State Governments exercised control over the sugar

industry.

8.4 After India's independence, the Central Government laid considerable emphasis on industrial development along with overall development particularly agriculture etc. As a first step in the direction of industrial development, the Government promulgated an Act - Industries (Development & Regulation) Act 1951. The Act envisaged details of means of industrial development in different sectors. Provision existed in the Act for Constitution of Councils to look after achievement of progress in different industries. Under this Act, the Development Council for Sugar Industry attends to the over-all development of sugar industry.

8.5 The present composition of the Development Council for Sugar Industry, vide Government of India,

Table - 5

Per Capita Consumption Of Sugar In Some Major Countries Of The World For The Year 1979.

Country	Per Capita Consumption (Kilograms)
Afghanistan	4.7
Australia	55.3
Austria	44.3
Bangladesh	1.9
Barbados	57.3
Brazil	50.2
Bulgaria	47.7
Burma	1.8
Canada	47.5
China	4.2
Cuba	52.6
Czechoslovakia	47.8
Egypt	22.0
German Democratic Republic	49.3
Iceland	54.6
India	10.2
Indonesia	11.1
Japan	27.6
Mauritius	45.2
Mexico	44.1
Poland	47.2
Sri Lanka	15.1
South Africa	37.7
Spain	30.7
Switzerland	42.0
U.K.	40.0
U.S.A.	43.1
U.S.S.R.	46.1

Ministry of Industry, Department Notification
F. No. 1/6/86-LP dated 22.10.1986, 'is as follows :

- Secretary, Department of Food, Ministry of Food & Civil Supplies, Chairman
- Jt. Secretary, Incharge of Sugar, Department of Food, Ministry of Food & Civil Supplies, Member-Secretary.
- Shri Mirza Irshashaig, M. P., Rajya Sabha Member.
- Shri R. S. Mane, M. P., Lok Sabha Member.
- Shri Syed Masudal Hossain, M. P. Lok Sabha Member
- Director General of Technical Development, Ministry of Industry, Department of Industrial Development, New Delhi, Member
- Chief Director, Directorate of Sugar, New Delhi, Member
- Director, National Sugar Institute, Kanpur, Member
- Economic Advisor, Department of Civil Supplies, New Delhi, Member.
- Jt. Advisor, Industry & Minerals Division, Planning Commission, New Delhi.
- Executive Director, IFC(I), New Delhi.
- Managing Director, National Federation of Co-operative Sugar Factories Ltd., New Delhi.
- The President, Indian Sugar Mills Association, New Delhi.
- Director, Deccan Sugar Institute, Pune
- Director, Sugarcane Breeding Institute, Coimbatore
- Director, Indian Sugarcane Research Institute, Lucknow.
- The President, National Federation of Co-operative Sugar Factories Ltd. New Delhi.

8.6 The Development Council, as mentioned earlier, looks after the overall development of sugar industry, including the licensing policy for sugar factories, internal consumption of sugar, working out sugar production targets, export and/or import of sugar, etc. etc.

8.7 The policy towards the issue of licences for establishment of new sugar factories, as announced by Government of India in accordance with the guidelines of Industrial Development & Regulation Act, 1951 indicated the following :

- Preference should be given for establishment of new sugar factories in the co-operative/public sector; in areas where proposals for the co-operative/public sector are not received, proposals from the private sector would be considered.

(ii) A new sugar factory can be installed where there is abundant sugarcane already existing; or good potential for the development of sugar cane exists in a compact area around the site of the proposed factory.

(iii) To ensure supply of adequate quantity of sugarcane to the existing unit as well as its further expansion, licence should not be granted for establishment of new sugar factory within a distance of 30 km of the existing units.

(iv) Where there are a large number of sugar factories located in one district, State Government should make proper zoning of sugarcane areas for each existing sugar factory or installation of new sugar factories in the district.

8.8 In order to process applications for new licence the Government of India had set up a Licensing Committee in the Ministry of Industrial Development which in association with the Screening Committee of Department of Food, Works and grant additional capacity on the basis of the following principles :

- (a) Availability of sugarcane and facilities for transporting raw materials to the factory.
- (b) Possibility of developing sugar cane cultivation in the area having regard to availability of irrigation facilities, weather conditions and other relevant factors.
- (c) Technical feasibility of and economic viability of the project.
- (d) Capacity of the entrepreneurs to complete the proposed project in time.

8.9 Generally the additional capacity to be installed, the Planning Commission gives guidelines to the Licensing Committee about the targets of sugar production to be achieved by the end of each Five Year Plan. These targets are initially worked out by the Working Group/Task Force constituted for the purpose in the Department of Food. The Working Group/Task Force takes into consideration, while making the recommendations, various aspects as outlined below :

- (i) Internal consumption
- (ii) Export of sugar
- (iii) Buffer stock requirements.

8.10 The internal consumption is computed by taking into consideration (a) population and the rate of increase thereof and (b) the per capita consumption and the increase thereof based on G. N. P. The population figures are obtained from the general census carried out every 10 years and the projected figures of increase in population from the Ministry of Home Affairs and

the Department of Economics and Statistics. Important data required for the purpose is the per capita consumption. International statistical figures relating to the per capita consumption indicate that the per capita consumption of sugar in India is rather low. (see Table 5)

8.11 The per capita consumption of crystal sugar in India was rather low in 1960-61, it was only 4.8 kg. It increased to 7.4 in 1970-71, later it remained rather static upto 1977. In the recent years, there is however, a tendency to increase; the per capita consumption of sugar in India increased to 8.2 kg. in 1978 and to 10.2 kg. in 1979. It may be added that the per capita consumption in India depends largely on the Government Policy of monthly release of sugar (vide infra) depending upon the availability of sugar stocks. Further, it is necessary to point out that the per capita consumption in India appears relatively lower than of other countries because the consumption in India of other sweetening agents such as gur and khandsari is not taken into account while computing the international statistics. The average consumption of gur and khandsari has been in the range of 12-16 kg; if this is also reckoned the per capita consumption of sweetening agents in India is around 26-30 kg, which is fairly comparable with other countries. The figure of per capita consumption is also considered as an index of the developed nature of the country, just as utilization of steel, etc. are referred to as index figure. Nevertheless, the consumption figure of crystal sugar alone are considered by the Planning Commission for assessing the installed capacity of sugar industry to be set up or the sugar production targets to be worked out during each Five Year Plan period.

8.12 Table 6 gives the targets and actual production of sugar during each of the Five Year Plan period.

8.13 It may be noted from the above figures that excepting in very few years, the production of sugar is far more than the targets set for by the Planning Commission. The fall in the production in some years was due to severe drought which affected the sugarcane crop. The target of sugar production in the Seventh Plan is being worked out by the Task Force of the Planning Commission. The target is likely to be around 93 lakh tonnes to meet the internal consumption of about 83 lakh tonnes including buffer stocks and the export requirements of about 10 lakh tonnes.

8.14 After the Plan targets are worked out, the Ministry of Industrial Development and the Department of Food in the Ministry of Civil Supplies work out the requirements of the installed capacity to be set up for production of the estimated quantity of sugar.

Thus, for the Sixth Plan period for production of 67 lakh tonnes of sugar, Government of India have issued licences for 81.6 lakh capacity in December, 1983. However, the installed capacity in December 1983 was 65.67 lakh tonnes. The gap of 15.94 lakh tonnes is due to establishment of new factories and the expansion of the existing units which are in the pipeline; 8.3 lakh tonnes of installed capacity is expected from

Table 6
Targets And Actual Production For 5 Year Plan Periods

Five Year Plan		Targets	Actual (Lakh Tonnes)
1)	1951 - 52 to 1955 - 56	15 (18)	18.90
2)	1956 - 57 to 1960 - 61	25	30.27
3)	1961 - 62 to 1965 - 66	35	35.36
4)	1969 - 70 to 1973 - 74	47	39.48
5)	1974 - 75 to 1979 - 80	60	
	1974 - 75		47.97
	1975 - 76		42.62
	1976 - 77		48.40
	1977 - 78		64.60
	1978 - 79		58.40
	1979 - 80		38.50
6)	1980 - 81 to 1984 - 85	76	
	1980 - 81		51.48
	1981 - 82		84.37
	1982 - 83		82.29
	1983 - 84		59.17
	1984 - 85		61.44
7)	1985 - 86 to 1989 - 90		
	1985 - 86		70.16

Note : The figure given in parentheses is based target.
There is a plan gap from 1966 - 67 to 1968 - 69.

Table 7
Specifications of Plantation White and Refined Sugars

Characteristic	Specifications	
	Plantation White Sugar	Refined Sugar
Polarisation	99.5% min	99.7% min
Invert Sugar	0.1% max	0.04% max
Conductivity Ash	0.1% max	0.04% max
Sulphated Ash	-	-
Moisture	0.1% max	0.1% max
Colour (Icumsa units)	150 max	60 max
Sulphurdioxide	70 mg/kg max	20 mg/kg max
Arsenic	1 mg/kg max	1 mg/kg max
Lead (Pb)	2 mg/kg max	2 mg/kg max
Copper (Cu)	2 mg/kg max	2 mg/kg max

setting up of 53 new factories and 7.35 lakh tonnes from expansion of the existing units. As the issue of licences for new factories and expansion of the existing units is a continuous process and the setting up of new factories and expansion of the existing programmes involve time, there is always a gap between the licensed and the installed capacities.

8.15 While giving the licence for achieving the target of production of sugar in each Plan period, Licensing Committee keeps in view the ratio of 60:40 for new factories and expansion of existing factories for achieving the additional capacity.

9. General Features of Sugar Factories in India

9.1 As mentioned earlier, sugar factories which had been set up during 1930's and earlier, were old and second hand plants, and were of low capacities in the range of 300 to 600 TCD. These were about 140 in number. These old factories had generally the following features :

- One set of knives driven by steam engine for preparation of cane.
- Mills were driven by steam engines.
- Mill rollers were of 24 x 48" and lower size, with mostly cast iron head stocks.
- Boilers were of low capacity, about 5 to 10 tonnes of steam generation per hour, with working pressure of 11 kg/cm² and below.
- Triple effect evaporators.
- Batch type setting tanks.
- Plate and frame type filter presses, low capacity pans with low circulation characteristics, a few pans having coils as heat exchangers.
- Central Condensate system with vacuum pumps
- Inadequate cooling arrangements for low grade massecuite system.
- Small size centrifugals either water-driven or belt driven.

9.2 It is important to point out that most of these factories had increased their crushing capacities during the last few decades either by using built-in margins in the plant or replacing the gears; in a few cases additional milling tandems were installed. Preparation of cane was improved by increasing the number of knives, adding another set of knives or by raising the power of knives. Steam generation capacity was also increased by installing new or second hand boilers. Capacity in the boiling houses was also increased with suitable additions. Some units were electrified

by installing steam driven generator sets or by taking power from the grid. Most of the old factories have increased their capacity from 800 to 1000 tonnes per day and some had gone even upto 1500 to 2000 tonnes per day. It is gratifying to point out that many of the old factories which were set up in 1930's or earlier, tried to keep themselves upto date, utilising the incentives and encouragement offered by Government of India. (see para 10)

9.3 Most of the Sugar factories which have been set up after 1955 were established with new plant and machinery. They were fairly modern in nature and they were initially of 1250 TCD capacity. Main features of the new plants are as follows :

- (a) Heavy duty knives driven by electrical motors.
- (b) The rollers of the mills are 30-60" with surface feeds being about 10 meters per minute.
- (c) The mills are sturdy and are capable of taking higher loads.
- (d) Boilers are of large capacities, with working pressure of 31 kg/cm² and above.
- (e) The plants are semi-electrified and are equipped with turbine operated power generating units.
- (f) Continuous clarifier and filters.
- (g) Quadruple effect evaporators with provision of vapour bleeding.
- (h) High capacity pans with better circulation characteristics.
- (i) Multijet condensers, separate for evaporators and pans.
- (j) Low grade crystallisers with cooling and reheating arrangements.
- (k) Electrically operating semi-automatic centrifugal machines with high gravity factor and bigger capacities.

9.4 It may be noted that out of 369 factories now operating in India, about 140 factories were with old machineries and required considerable amount of rehabilitation and modernisation.

10. Government of India's Scheme for Rehabilitation and Modernisation of Sugar Industry :

10.1 A notable step taken by Government of India for rehabilitation and modernisation of the sugar industry (including cotton textile and jute and engineering industry) as announced in 1976-77. The Industrial Development Bank of India (IDBI) was asked to give concessional finance for modernisation and rehabilita-

tion of the selected industries including sugar, to enable them to modernize their machinery and equipments so as to increase their productivity and effectiveness. The basic criteria for assistance would be the weakness or non-availability of the industrial concern arising out of technological and equipmental obsolescence. Sugar factories which were not in a position to bear normal lending rate of interest of the financial institutions would be provided concessional assistance to the full extent of the loan. The scheme generally known as "Soft Loan Scheme" has been administered by a consortium of financing institutions like Industrial Development Bank of India (IDBI), Industrial Credit and Investment Corporation of India Ltd. (ICICI), and Industrial Finance Corporation of India (IFCI). The eligibility criteria for a sugar factory to be entitled to the soft loan, are as follows :

- (i) Expansion of the daily crushing capacity upto 1500 tonnes per day.
- (ii) Importance in thermal efficiency by replacing the existing low pressure boilers by high pressure boilers.
- (iii) Installation of waste heat recovery units like economisers and air pre-heaters.
- (iv) Installation of steam saving devices like pre-evaporators, vapour line juice heaters, etc.
- (v) Semi-electrification of the plant by installing power generator and replacing the steam driven pumps by electrical driven pumps, etc.
- (vi) Replacement of the existing plant and machinery for improving the mill efficiency, boiler house efficiency and quality of sugar.

10.2 Large number of old sugar factories had approached the financial institutions for sanction of soft loans. Some of them had been benefited immensely by the scheme. Some others could not meet the financial parameters laid down by the institution, namely 10% of the cost of the scheme of rehabilitation had to be financed by the promoter and therefore, failed to derive the benefit from the scheme. However, the scheme in general had helped in modernization and expansion of some of the old factories in the country.

10.3 In the national budget for the year 1981-82, there was an increase in the interest rate. The rate of interest was increased from 8.2 to 12.5%, as such the soft loan scheme became virtually non-operative.

11. The Standard Specifications of the Government of India and the General Features of the New Factories

11.1 The plant and machinery of the new factories

which have been set up after 1956 were according to the specifications drawn by a Technical Committee appointed by Government of India in 1960 and 1970. The specifications for the new plants were drawn by the Technical Committee and modern developments in equipmental and process factors were incorporated. During the last 10 years from 1970 to 1980, several technical and equipmental innovations had taken place in addition, it was felt that the specifications for plant and machinery for 1250 TCD factory drawn in 1970-72 should be revised; that the initial capacity, 1250 TCD; for a new sugar factory is low. Consequently, the Government of India had recently appointed another Technical Committee to draw up the specifications for the plant and machinery for sugar factories for an initial capacity of 1500 TCD; easily expandable upto 2500 TCD. The composition of the Committee is as follows :

1. Director, National Sugar Institute, Kanpur, Convenor
2. Chief Director, Directorate of Sugar, New Delhi, Member
3. Additional Chief Director, Directorate of Sugar, New Delhi, Member
4. A representative of the National Federation of Cooperative Sugar Factories Ltd., New Delhi, Member
5. A representative of the National Cooperative Development Corporation, New Delhi, Member
6. A representative of the Indian Sugar Mills Association, New Delhi Member
7. A representative of the Directorate General of Technical Development, New Delhi, Member
8. A representative of the Industrial Finance Corporation of India, New Delhi, Member
9. The Director, Deccan Sugar Institute, Pune, Member
10. One Technical Representative from each of the following sugar machinery manufacturers:
 - (a) Walchandnagar Industries Ltd., - Member Walchandnagar
 - (b) Buckau Wolf India Ltd., Pimpri, Pune
 - (c) Indian Sugar and General Engineering Corporation, Yamunanagar
 - (d) K. C. P. Ltd., Madras
 - (e) Engineering Projects India Ltd., New Delhi
 - (f) Textile Machinery Corporation Ltd., Calcutta
 - (g) Triveni Engineering Works Ltd., Naini, Allahabad

(h) National Heavy Engineering Co-operative Ltd., Pune

11. The Director (Food and Agriculture Project Division), Indian Standards Institution, New Delhi, Member
12. A representative of the Sugar Technologists Association of India, Kanpur, Member
13. A representative of the Government of Maharashtra, Member
14. A representative of the Government of Uttar Pradesh, Member
15. A representative of the Government of Tamil Nadu, Member
16. Shri S. C. Sharma, Technical Adviser, Cawnpore Sugar Works, Kanpur, Member
17. Shri H. N. Gupta, Chief Design Engineer, National Sugar Institute, Kanpur, Member Secretary.

11.2 This Committee is reported to have done considerable amount of work to introduce modern concepts in the plant and machinery for a 1500 TCD plant. These are briefly as follows :

- (i) Better preparatory devices such as fiberizer, shredder, etc.
- (ii) Better extraction devices like mills with individual drives by high power turbines.
- (iii) Better feeding devices like donnely chutes under feed rollers, etc.
- (iv) High pressure boilers for maximum steam and power economy.
- (iv) Low head and high capacity pans.
- (vi) Continuous vertical cooling crystallisers.
- (vii) Highly efficient continuous centrifugal machines etc.

11.3 The Committee had finalised one report in May 1985. The specifications of the Plant and Machinery involved fairly large number of new and modern innovations. However, the same remains possibly of no avail in view of the new policy declared recently by Government of India, in respect of the initial capacity of new factories to be licenced.

11.4 The policy of issue of licences to new sugar factories and for expansion of existing factories has attracted attention from time to time of the Government of India. Based on the recommendations of Sen Commission, etc., a factory of 1250 TCD as initial capacity was considered economical, later in 1984, it was considered that the initial capacity should be raised to 1500 TCD; the Government of India constituted

(iv) New units would normally be licensed for an initial capacity of 2500 TCD and expansion in existing units would be allowed up to 3500 TCD. Proposals for expansion of existing units upto a maximum of 5000 TCD would be permitted, provided the entire additional requirement of sugarcane accrues through increased productivity and not by expansion of area.

(v) Establishment of new Sugar Units in backward areas may be given priority subject to adequate cane availability and techno-economic feasibility.

(vi) State Governments/Sugar Factories would be advised to intensify programmes for cane development. Sugar factories would also get loan facilities on Soft Terms for sugarcane development from the Sugar Development Fund administered by the Department of Food.

11.6 In order to prepare another Standard Specification for a sugar factory of initial capacity of 2500 TCD, with incorporation of maximum automation and modern energy saving devices, a technical committee for revising the Standard Specifications for Sugar Plants was reconstituted recently in January 1987, with the following composition :

1. Shri V. Lakshmi Ratan, Department of Food, Chairman
2. Shri Ram Kumar, National Sugar Institute, Convenor
3. Shri S. K. Chattopadhyay, Directorate of Sugar, Member
4. Shri P. J. Manohar Rao, National Federation of Cooperative Sugar Factories, Member
5. Shri N. K. Sawhney, National Cooperative Development Corporation, Member
6. Shri R. V. Rao, Director General of Technical Development, Member
7. Shri V. G. Gupta, Industrial Finance Corporation of India, Member
8. Shri J. P. Mukherjee, J. P. Mukherjee and Associates, Member
9. Shri S. C. Sharma, Champaran Sugar Works, Member
10. Shri K. N. Shukla, Walchandnagar Industries, Member
11. Shri V. J. Mehta, Protos Engineering (P) Ltd., Member
12. Shri J. Satyanarayana, KCP Limited, Member
13. Shri A. L. Bose, Textile Machinery Corporation Ltd., Member

14. Shri D. Das, Triveni Engineering Works Ltd., Member
15. Shri N. G. Joshi, National Heavy Engineering Cooperative Ltd., Member
16. Shri R. S. Shukla, U. P. Cooperative Sugar Factories Federation, Government of Uttar Pradesh, Member
17. Shri A. P. Chinnaswamy, Directorate of Sugar, Government of Tamil Nadu, Member

12. Quality of Sugar and Price of Sugar

12.1. The sugar that is manufactured in India is that is called direct consumption plantation white sugar. It may be pointed out that in other countries like U. K., Canada, Japan, etc. refined sugar of 99.9% purity is produced ; for this purpose , raw sugar of 97-98% purity produced from cane by adopting simple lime clarification (defacation) technique, is, melted and the melt is refined with activated carbon, ion exchange resin, etc. Raw sugar is manufactured mainly for export purposes in countries like Philippines, Cuba, Brazil etc. Instead of producing white refined sugar first by manufacturing raw sugar from cane and then melting and refining the raw sugar crystals - India and few other countries like Indonesia, Jawa, Burma, Pakistan, Sudan, Egypt etc. produce white sugar directly from the plantation of the cane.

12.2 The plantation white sugar of which the maximum quantity is manufactured in India, has the following characteristics (for comparison, the characteristics of refined sugar are also given).

12.3 The technology of manufacture of plantation white sugar is not discussed in detail here. It suffices to mention that cane juice is subjected to intensive clarification by lime and carbon di-oxide (Carbonation process) or lime and sulphur di-oxide (Sulphitation process). About 40 factories mainly situated in the Northern India adopt carbonation process and all the rest of the factories (about 329 operating in India employ sulphitation process for clarification of cane juice.

12.4 Commercial transaction, i.e. sale of sugar, is generally on the basis of the colour in sugar solution or by visual comparison. In India the same is entirely by the latter method. For this purpose, the sugar produced in a factory is compared (in solid state) with standard sugar samples issued year after year by the Bureau of Sugar Standard under the aegis of the National Sugar Institute, Kanpur and after approval by the Development Council for the Sugar Industry.

These standard sugar samples are supplied in sealed square colourless glass bottles. The sugar produced in a factory is put in a similar empty bottle and compared with the standard. Sugar produced in India is graded for both grain size and for colour. The grain size grades are designated as :

Grade	Grain Size Requirements	
	Passing through IS sieve	Retained on IS sieve
A	2.36 mm	2.00 mm
B	2.00 mm	1.70 mm
C	1.70 mm	1.18 mm
D	1.18 mm	0.85 mm
E	0.85 mm	0.60 mm

12.5 The colour of sugar has been referred to by arbitrary numbers 18, 19, 20, 24, 30 etc. During early 1950's, the colour quality of sugar produced was not as good as of today and it used to be somewhat off-colour, instead of pure white. The sugars had colour (in the solution phase) more than 200/ICUMSA units; in the 156 Grade, they were of 24 and 25 in colour series. With the development of many technological innovations such as adoption of improvements in clarification and pan boiling and massecuite curing techniques it is gratifying to point out that Indian Sugar Industry

has made considerable technological progress and there is tremendous amount of improvement in the colour of sugar.

12.6 In some factories the sugars produced are almost equal in visual colour quality to the refined sugar. The colour of Indian Sugar now being produced is in the range of 60-150 ICUMSA units. The visual ISS colour grades in vogue are 29 and 30, the latter being of superior quality. Government of India now permits the sale of Indian sugar in the form of ten grades; 30A, 30B, 30C, 30D and 30E; and 29A, 29B, 29C, 29D and 29E. The standard bottles of these grades are issued as mentioned earlier year after year and each factory grades and sales its sugar in accordance with these ten grades.

12.7 Studies on the use of reflectance methods, the IS colour grade viz., 27, 28, 29 and 30 have been defined in physical terms. The modulated reflectance values (MR) of white sugars of different grain sizes have been computed; they have a specific relation to the grain size (see Fig. 4). One angle of the straight line relating to different colour series with the horizontal are as follows :

Colour	Angle
27	9°
28	13.5°
29	18°
30	20°

Table 8

Percentage of Quality-wise Production of Sugar during the Years 1972 to 1985

I. S. S.no.	72-73	73-74	74-75	75-76	76-77	77-78	78-79	79-80	80-81	81-82	82-83	83-84	84-85
A 30	0.75	0.80	0.61	0.74	0.62	0.48	0.52	0.60	0.31	0.18	0.12	0.10	L-30 4.05
B 30	3.81	4.06	2.68	3.22	4.11	3.76	4.07	0.56	3.50	2.90	3.72	4.19	M-30 32.35
C 30	29.06	27.57	21.98	29.98	26.44	22.79	29.43	29.69	26.71	23.80	26.02	32.00	S-30 61.17
D 30	40.82	39.17	38.72	45.78	47.10	44.79	46.95	44.26	51.01	50.22	51.53	47.26	
E 30	17.83	19.75	10.56	13.88	17.91	17.04	13.59	14.58	15.63	18.12	15.30	12.70	
TOTAL	92.27	91.35	74.55	93.60	96.18	88.86	94.56	93.69	97.16	95.22	96.69	96.25	97.37
A 29	0.02	0.03	0.14	0.02	0.02	0.01	0.04	0.13	0.01	0.03	-	-	L-29 0.06
B 29	0.26	0.32	0.84	0.16	0.12	0.50	0.47	0.30	0.16	0.17	0.30	0.24	M-29 1.05
C 29	2.60	2.88	6.78	1.52	1.01	2.86	2.14	2.23	2.67	1.27	1.09	0.99	S-29 0.78
D 29	3.14	3.21	11.05	3.56	1.65	4.68	1.86	2.28	1.18	1.93	1.13	1.19	
E 29	1.08	0.74	6.20	0.72	0.59	2.69	0.47	0.75	0.32	0.98	0.35	0.42	
TOTAL	7.10	7.18	25.01	5.98	3.39	10.74	4.98	5.69	2.34	4.38	2.87	2.84	1.89
Ungraded	0.63	1.47	0.44	0.42	0.43	0.40	0.46	0.62	0.50	0.40	0.40	0.91	0.54

12.8 The Sugar Institute in Britain had also developed physical designations for different colour series from reflectance values at wavelengths 426 and 620 mu these grades are called Bruinswig colour grades.

Type of Sugar	Ratio of Reflectance at Wavelength 426/620
0	0.952
1	0.915
2	0.875
3	0.842
4	0.805
5	0.768
6	0.731

12.9 In France too, similar methods of measurement of reflectance values for different colour grades have been developed; these are referred to as Paris grades.

Type of Sugar	Reflectance Ratio
0	0.959
1	0.917
2	0.867
3	0.820
4	0.782
5	0.736

12.10 It may be pointed out that D 30 of ISS grade of Indian Sugar is roughly equivalent to Bruinswig to Paris grade, some what between 1 and 2.

12.11 It may be added here that the above five grain size grades with certain designated colour series were in vogue for long time. From the year 1963 onwards, there were proposals or considerations for abolition of the bolder grain size grades, viz., A, B and C particularly, because of excessive melting. Steam and equipment required in abundance for their manufacture without much impact on the quality or sugar content of these grades. The Development Council for Sugar Industry at its meeting held on 26th April, 1975 constituted a Committee under the Chairmanship of Shri S. V. Sampath the then Joint Secretary in the Department of Food for examining the grain sizes issue. The following were the members of the Committee :

- (a) Shri S. V. Sampath, Jt. Secretary (Sugar).
- (b) Dr. N.A. Ramaiah, Director, National Sugar Institute, Kanpur
- (c) Dr. S. V. Ingale, Manager (QC), Food Corporation of India, New Delhi.

- (d) Shri T. Paramanandam, Head Agri. & Food Division, Indian Standards Institute, New Delhi.
- (e) Shri Mangal Singh, General Manager, Godavari Sugar Mills, Bombay.
- (f) Shri N. S. Jain, Managing Director, National Federation of Cooperative Sugar Factories Ltd., New Delhi.
- (g) Shri D. D. Puri, Indian Sugar Mills Association, New Delhi.
- (h) Shri J. C. Pant, Managing Director, U. P. State Sugar Corporation, Lucknow.
- (i) Shri S. N. Gundurao, Advisor, Deccan Sugar Institute, Pune.
- (j) Shri N. C. Verma, Maharashtra Rajya Sahakari Sakhar Karkhana Sangh Ltd., Bombay.
- (k) Shri P. J. Manohar Rao, Director (Technical), Directorate of Sugar, Department of Food, New Delhi.

12.12 The points of refernece were keeping in view the statistics relating to the production of different grades of sugar in all the existing sugar factories, the Committee may examine the possibility of reducing the number of existing Indian Sugar Standards and more particularly the desirability and feasibility of having only one Indian Standard grade of sugar.

12.13 The Committee collected statistics for production of sugar for the previous five years, price differentials for various grades of sugar etc; and also obtained the views of industry. It constituted a sub-committee or group of technologists on 30th June, 1976.

12.14 The main Committee considered the recommendations of the group and finally made, on 18th September 1982, the following recommendations to the Development Council :

- (i) The two colour series viz. 29 and 30 IS colour grade (see below) should continue.
- (ii) The question of introducing a new colour series ISS 31 should be considered by the Standing Advisory Committee of Sugar Standards.
- (iii) The existing five grain size grades should be reduced by three standards by adopting the following procedure :
 - (a) Combine the existing A and B grain size and consider the same as large grain size grade.
 - (b) The existing C grain size grade will be designed as Medium M grade.
 - (c) Combine D & E grain sizes and designate the same small S grain size grade, as indicated below :

Grain size Grade designation	Passing through I.S. Sieve	Retain on I.S. Sieve
L	2.36 mm	1.70 mm
M	1.70 mm	1.18 mm
S	1.18 mm	0.60 mm

(d) Grade S 29 may be considered as the base grade for purposes of computation of price differentials

12.15 The Development Council for Sugar Industry on 30th December 1986 considered the Committee's recommendations and decided to introduce the revised grades L, M and S in the two colour series of 29 and 30 from the beginning of the sugar season 1984-85.

13. Sale Price of Sugar

13.1 Prior to 1942, sugar produced by factories was sold at price controlled by the market forces. During World War II, there was an acute shortage of sugar and as supply of sugar to the Armed Forces was found essential, imposition of controls in April 1942, under Sugar Control Order was issued by Government of India. Under this Order (later amended as Sugar and Sugar Products Control Order) no sugar factory was permitted to sell its sugar to persons other than those authorised by Sugar Controller. Sugar Syndicate consisting mostly the representatives of Sugar factories, consumers, etc. used to look after generally the sale of sugar and other affairs. U. P. and Bihar used to be the States of surplus sugar production. Sugar from these States was allocated to other deficit States by the Sugar Controller. After India's independence, the Indian Sugar Syndicate became the sole selling organisation under the power vested by the Essential Supplies (Temporary Powers) Act, 1949, the Syndicate used to fix ex-factory price of sugar. With the setting up, of Directorate of Sugar in the Government of India in 1952-53, the control of sugar price and distribution was taken over by the Central Government. Whenever the production of sugar was in excess, the sugar prices were expected to be low, and the consumer was not likely to be affected, the Government relaxed the control system and did not fix any ex-factory price for sugar. Whenever sugar production in the country decreased, and the sugar stocks were low; and the consumer was likely to be affected, the Government imposed control on sugar released and also on price. In 1958 (July), Government had to adopt other measures for effective control on the availability of sugar to one and all; some of these measures are:

(a) Licencing of whole-sale dealers in sugar by State Governments;

- (b) Assigning of specific quota to individual State;
(c) Banning Inter-State movement of sugar, etc.

13.2 The Government policies of control on price and on distribution of sugar have been mainly governed by the amount of sugar produced or available in a year with a view to enable the consumer to purchase sugar at a reasonable price.

13.3 It is important to point out that the policy of control which involves fixing of ex-factory price, set a limitation on the price payable to the raw material viz. cane, during control periods the same had to be only the minimum statutory cane price. When the cane price was not attractive or remunerative, either the acreage under cane decreased, leading to fall in over-all production of cane, or diversion of cane to other commodities like gur and khandsari, (on the price of which there was no control). Under the regime of price control operation in 1966-67, the production of sugar declined to about 21 lakhs. It was feared that the production of sugar likely to fall even upto 15 lakh tonnes, which would not be sufficient at all for the internal demand. There was no possibility of adequate cane coming to sugar factories unless cane price higher than the minimum statutory cane price was paid to farmers, which was not possible under the system of ex-factory sugar price control. It was under these circumstances that Shri Jagjeevan Ram, the then Union Minister for Food & Agriculture (in-charge of sugar industry) announced in August 1967 a system of partial de-control of sugar. Under this policy, 60% of the production of sugar will be procured from sugar factories at a fixed 'Levy' price by the Government and the factories will be free to sell the balance of sugar anywhere in India in the free market at any price, subject to the releases from factories to be sanctioned by Government of India. The sale of 40% of production at price higher than levy price (which has been computed taking into consideration of the statutory minimum cane price) enabled factories to pay cane price higher than the statutory minimum cane prices to farmers and attract more or adequate cane. This policy of partial de-control of sugar seems to have averted the crisis; the production of sugar in 1969-70 went upto 42.6 lakh tonnes.

13.4 Depending upon the assessment of sugar production; requirement of internal consumption; the need to provide sugar at reasonable price to the consumer and the necessity to enable payment of remunerative cane price to the farmers, the Government of India has been operating sugar policy mechanism through control, over the last 40 years. The following statement gives the periods of control, de-control and partial control that the sugar industry has been passing through during last 4 decades.

1941-42 to 1946-47	Control
1947-48 to 1957-58	De-control
1958-59 to 1960-61	Control
1961-62 to 1962-63	De-control
1963-64 to 1966-67	Control
1967-68 to 1977-78	Partial control with levy-free sale ratio 60:40, 70:30, 65:35 etc.
1979-80	Control
1979-80 (from 17.12.79) to 1984-85	Partial control with 65:35 as the Levy and free sale ratio.
1985-86	Partial control with levy-free sale ratio 55:45
1986-87	Partial control with levy-free sale ratio 50:50.

13.5 The levy price of sugar was being fixed by Government of India, ever since the sugar industry came under its control. The price fixation is carried out with the help of technical and costing experts. The first sugar price schedules were prepared in 1941-42 by late Shri Srivastava, the then Director of Imperial Institute of Sugar Technology (now the National Sugar Institute), Kanpur; later, the work was undertaken by Gopalkrishna Committee, the Sen Commission (1965); and Tariff Commission was wound up, the work was entrusted in 1980 to High level Committee under the Chairmanship of Shri L. Kumar of Bureau of Industrial Cost and Prices; the schedules of the High Level Committee were in force from 1980-81 season. Recently (in 1982) the Government of India had requested the BICP to work out the revised sugar cost schedule. Government of India had announced the scheduled worked out by the High Level Committee would remain in force for the season 1983-84 too.

13.6 Normally the schedules working out in a year on the basis of the data on the cost of production of sugar in different agro-climate regions or zones remain in force for about 3 seasons. The cost data related to various components required for production of one quintal of sugar such as :

- (i) Cost of cane (not only cane price paid to the farmer, but also other expenses incurred like commission, cane development, purchase tax, transportation, etc.)
- (ii) Power
- (iii) Steam
- (iv) Fuel (other than bagasse)
- (v) Factory repairs and maintenance of stores, salaries and wages
- (vi) Packing
- (vii) Depreciation
- (viii) Interest
- (ix) Overheads

- (x) Godown rent, commission, etc.
- (xi) Return on capital, etc.

The credits accruable by the factory due to sale of molasses, press mud, bagasse, dunnage and other miscellaneous items are also reckoned. The average of the actual cost of production of sugar in different selected factories of various zones form the base for preparing their schedule, which are employed by the Department of Food for working out the actual levy price of sugar for a given year and for each zone taking into consideration the minimum statutory cane price announced for the concerned year, escalations, recovery and duration of the season envisaged. The following Table 9 gives levy price fixed for D 29 grade of sugar (excluding excise duty) for the years 1980-81 to 1986-87.

14. Government of India's Recent Schemes for Development of Sugar Industry

14.1 In line with the hike in prices of all commodities the cost of machinery of sugar plants also increased by leaps and bounds, during the last two decades. In 1957, the cost of standard plant of 1250 tonnes capacity was Rs.90 lakhs; in 1973, Rs.250 lakhs; in 1974, Rs.320 lakhs. The unprecedented rise in the cost of plant and machinery set a limitation to the progress of establishment of new factories and expansion of existing units. The gap between the licenced and installed capacity increased to alarming levels. Most of the licences could not be implemented due to high cost of plant and machinery; the position of economic viability of sugar units went out of gear. To examine the situation, Government of India appointed a Committee under the Chairmanship of Shri S.V.Sampath, Joint Secretary, Department of Food in the Ministry of Agriculture and Irrigation. The composition of the Committee was as follows :

1. Shri S. V. Sampath, Joint Secretary (Sugar), Department of Food, Chairman
2. Shri S. S. Puri, Joint Secretary, Planning Commission, Member
3. Shri N. Sethuraman, Director, Department of Banking, Ministry of Finance, Member
4. Shri K. P. Anand, Deputy Secretary, Department of Revenue and Insurance Department of Finance, Member
5. Shri S.M. Ghosh, Joint Secretary, Ministry of Heavy Industry, Member
6. Shri A. Das, Joint Secretary, Department of Cooperation, Ministry of Agriculture, Member

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| 7. Shri N. K. Prabhakar Rao, Chief Director,
Directorate of Sugar & Vanaspati, Member | 12. Shri Bhadur Murao, Member, Bureau of Industrial
Costs & Prices Sugar Factories, Member |
| 8. Shri R. P. Khosla, Managing Director, U. P. State
Sugar Corporation, Lucknow, Member | 13. A Representative of the National Federation of
Cooperative Sugar Factories Ltd., Member |
| 9. Shri M. S. Gill, Managing Director, National
Cooperative Development Corporation, Member | 14. Shri K. Padmanabhaiah, Director of Sugar,
Government of Maharashtra, Member |
| 10. Shri Baldev Pasricha, General Manager, Industrial
Finance Corporation of India, Member | 15. Shri P. J. Manohar Rao, Director (Technical),
Directorate of Sugar & Vanaspati, Member |
| 11. Shri R. Rajgopalan, Chief Cost Accounts Officer,
Ministry of Finance, Member | |

Table 9

Levy Price fixed for D 29 Sugar (Excluding Excise Duty) Rs. Per Quintal

Zone / Region	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87
Punjab	317.67	302.67	303.16	335.26	335.26	379.12	396.95
Haryana	308.75	316.00	309.31	341.37	341.37	402.61	407.01
Rajasthan	311.97	331.41	347.66	372.07	372.07	419.60	456.01
Western U. P.	281.81	275.15	276.56	299.66	299.66	425.05	427.38
Central U. P.	294.35	289.11	304.30	318.33	318.33	420.84	413.68
Eastern U. P.	316.26	311.96	305.13	331.32	331.32	451.22	441.73
North Bihar	322.82	314.58	307.10	336.59	336.59	427.49	436.07
South Bihar	344.90	388.61	388.99	429.05	429.05	515.68	530.15
Gujarat	270.81	282.90	289.09	295.39	295.39	362.36	
South Gujarat *							366.11
Saurashtra							411.68
Madhya Pradesh	344.12	362.91	355.73	362.05	362.05	454.35	474.64
Maharashtra	270.18	280.94	283.31	296.81	296.81	372.79	
South Maharashtra *							381.74
North Maharashtra							399.23
Karnataka	279.17	280.57	280.01	299.19	377.8	361.91	299.19
Andhra Pradesh	287.27	293.00	301.86	321.27	321.27	367.44	378.34
Tamil Nadu	297.14	302.05	307.89	328.51	328.51	390.66	392.69
Pondicherry	297.14	302.05	307.69	328.51	328.51	390.66	392.69
Orissa	320.42	312.27	332.74	342.82	342.82	413.89	413.56
Assam	320.42	312.27	332.74	342.82	342.82	413.89	413.56
West Bengal	320.42	312.27	332.74	342.82	342.82	413.89	413.56
Nagaland	320.42	412.27	332.74	342.82	342.82	413.89	413.56
Kerala	273.82	299.29	316.18	346.96	346.96	428.54	448.01
Goa	273.82	299.29	316.18	346.96	346.96	428.54	448.01
Average	283.74	289.56	293.74				

* From the season 1986-87, Gujarat has been divided into two price zones - South Gujarat & Saurashtra; Maharashtra into price-zones - North and South Maharashtra Including Rs.26/- per quintal

Secretary

The terms of reference were :

- (i) to examine the cost of establishing a new sugar factory of 1250 TCD crushing capacity and suggest ways and means of reducing the total cost of such project;
- (ii) to suggest minimum economic size of new sugar factories in the context of increasing cost of construction, plant and machinery; and
- (iii) to suggest various incentives and other measures for new sugar factories economically viable.

14.2 The Committee suggested that the following incentives may be accorded for new sugar factories and expansion projects in existing factories :

For New Factories :

(a) The period of operation of the scheme was for five years from the date of commencement of production, in each of the new sugar factories as the economic viability of a sugar factory depends on the availability of sugarcane, sugar recovery, duration of crushing etc. which vary widely from region to region due to agro-climatic and other factors. The sugar producing zones in the country may be classified for purpose of the incentives scheme into low, medium and high sugar recovery areas.

(b) The criteria for classification for the three areas is :

- (i) Low recovery area - the zone where average recovery of sugar during 5 seasons preceding 1975-76 season had been below 9.0%.
- (ii) Medium recovery area - the zone where the recovery of sugar during the 5 seasons preceding the season 1975-76 has been 9.0 and above but below 10%.
- (iii) High recovery area - the zone where the average recovery of sugar during 5 seasons preceding 1975-76 has been above 10%.

(c) Incentives should be effective from November 1974 and applied to all units commencing production during the period between the said date and 31st October 1980. New units which commence production after 1st April 1974 and before 1st November 1975 will also be eligible to get benefit of the scheme.

(d) The incentives are linked to the actual cost of 1250 TCD plant as prescribed by the Government of India (excluding optional items such as FOR-machinery manufacturers' works basis). Concessions are available if the cost of the plant and machinery is above 200 lakhs subject to the maximum of Rs.400 lakhs. The percentage of levy and free quota of sugar for the different slabs of the cost of the plant and machinery for low, medium and high recovery areas is given in Table 10.

Table 10
Levy-Free Sale Quotas

Recovery Zone	Cost of Plant & Mach (Rs./Lakh)	200 to 220	220 to 240	240 to 260	260 to 280	280 to 300	300 to 320	320 to 340	340 to 360	360 to 380	380 to 400	400 to above
High Recovery												
1st Year		60	64	68	72	76	80	84	88	92	96	100
2nd Year		60	64	68	72	76	80	84	88	92	96	100
3rd Year		60	63	65	67	70	72	75	77	80	82	85
4th Year		60	61	62	63	64	65	66	67	68	69	70
5th Year		45	45	46	46	47	47	48	48	49	49	50
Medium Recovery												
1st Year		70	73	76	79	82	83	88	91	94	97	100
2nd Year		70	73	76	79	82	85	88	91	94	97	100
3rd Year		70	73	76	79	82	85	88	91	94	97	100
4th Year		55	57	59	61	63	65	67	69	71	73	75
5th Year		45	45	46	46	47	47	48	48	49	49	50
Low Recovery												
1st Year		70	73	76	79	82	85	88	91	94	97	100
2nd Year		70	73	76	79	82	85	88	91	94	97	100
3rd Year		70	73	76	79	82	85	88	91	94	97	100
4th Year		70	73	76	79	82	85	88	91	94	97	100
5th Year		40	40	43	43	46	46	49	52	52	52	55

14.3 Sugar factories will pay excise duty on the higher free sale quota allocated, in accordance with the normal rates applicable to the existing units on the basis of 65:35 ratio of levy free sale sugar.

For Expansion Unit

14.4 The scheme for expansion unit is effective from 1st November 1975 and apply to all units completing licenced expansion programme during the period between the said date and 31st October 1980.

14.5 The incentives are available for a period of 5 years from the year of completion of any licenced expansion programme irrespective of the quantum of expansion and cost of expansion (later clarified to state that the investment for expansion should be more than Rs.1 crore). The percentage of levy-free quota of sugar in the high, medium and low recovery areas will be as follows :

Table 11
Percentage of Levy-free Quota

Year of production	High Recovery Areas	Medium Recovery Areas	Low Recovery Areas
1st year	65	65	70
2nd year	55	60	70
3rd year	50	55	60
4th year	50	50	55
5th year	45	45	45
6th year	35	35	35

14.6 In spite of the high free-sale quotas allowed, the expanded units will be required to pay excise duty in accordance with the normal rates applicable to the existing units on the basis of 65:35 ratio of levy and free sale sugar.

14.7 With the advent of sugar de-control effected in August 1978 the Sampath Committee incentives scheme became almost inoperative. Later, the inter-ministrial group constituted by the Ministry of Agriculture and Irrigation, examined the matter and revised incentives scheme. The changes referred to are briefly as follows :

-- The date of eligibility of incentives for new sugar factories has been advanced from 1.4.1978 to 1.10.1983.

-- Incentives would also be permitted to new factories with capacities higher than 1250 TCD.

-- All licenced expansion projects involving a capital cost of Rs.1 crore and above would be eligible (including the cost of fixed assets like land, building foundation, plant and machinery works basis).

-- The cost of old plant and machinery purchased either to set up new factories or for expansion projects will not be taken into account.

14.8 The Government of India had, however, directed that the new factories already licenced which would commence production within a maximum period of 39 months from the month succeeding the month in which the revised scheme is announced, would only be eligible to the benefit of the scheme and that new sugar factories to be licenced in the VI Plan starting production within a period of 39 months from the date of their licence or letter of intent, whichever is earlier, also be entitled to grant of incentives. The same is also applicable for expansion projects.

14.5 The Sampath Committee had also suggested that various State Governments may consider exemption of all new sugar factories from payment of purchase tax on sugarcane upto the same level of sugar production for which excise rebate is allowed by the Central Government. As a result of this scheme a number of new sugar factories had been licenced and expansion programmes had come into effect and the sugar production continuously increased from 1974-75 onwards. With the change of sugar price from time to time, consequent general levy free sale ratios and variations in the excise duties etc., it became necessary to modify Sampath Committee Scheme of incentives to enable factories to obtain expected financial assistance. The scheme therefore underwent considerable change. The present scheme representing the percentage of free sale quota for different slabs of plant and machinery cost is indicated in table No. 12.

14.9 It is of interest to point out that large number of factories have taken advantage of the scheme from 1975. As on 27.2.1987, 30 factories in Joint Stock Sector, 217 in the Cooperative Sector and 18 in the Public Sector have been benefitted. The names of factories, sector-wise are given in table -13.

15. Sugarcane Development Fund Act, 1982

15.1 To facilitate rehabilitation and modernisation of the sugar industry and for making grants for purpose of any research project aimed at development of sugar industry, the Government of India had enacted two Acts, namely, the Sugar Research Act 1982 and the Sugar Development Fund Act, 1982. These Acts came into force from 1st June 1982; to empower the Government of India to collect cess at the rate not exceeding Rs.10/- per quintal of sugar. Initially Rs.5/- per quintal

Table 12

**Percentage of the Free Sale Quota for Different Slabs of
Plant and Machinery Cost
(New Units)**

Slabs of Plant & Machinery Cost - Rs./Lakhs

Recovery Area	200 & above but less than	220 & above but less than	240 & above but less than	260 & above but less than	280 & above but less than	300 & above but less than	320 & above but less than	340 & above but less than	360 & above but less than	380 & above but less than	400 & above but less than
		220	240	260	280	300	320	340	360	380	400
High											
1st Year	49	53	57	61	65	69	74	78	82	87	90
2nd Year	46	50	53	56	59	63	67	70	73	77	80
3rd Year	44	46	49	52	54	57	60	62	65	67	70
4th Year	41	43	45	47	49	51	53	54	56	58	60
5th Year	40	42	43	45	46	48	49	51	52	54	55
Medium											
1st Year	64	67	71	75	78	82	85	89	93	96	100
2nd Year	64	67	71	75	78	82	85	89	93	96	100
3rd Year	64	67	71	75	78	82	85	89	93	96	100
4th Year	64	67	71	75	78	82	85	89	93	96	100
5th Year	48	50	51	51	55	55	59	60	60	63	65
Low											
1st Year	73	76	79	81	84	87	89	92	95	97	100
2nd Year	73	76	79	81	84	87	89	92	95	97	100
3rd Year	73	76	79	81	84	87	89	92	95	97	100
4th Year	73	76	79	81	84	87	89	92	95	97	100
5th Year	73	76	79	81	84	87	89	92	95	97	100
6th Year	73	76	79	81	84	87	89	92	95	97	100
7th Year	73	76	79	81	84	87	89	92	95	97	100
8th Year	62	62	62	67	67	67	70	70	70	73	75

Percentage of the Free Sale Quota (Expansion Projects)

(Applicable to Expansion Projects costing above Rs. One Crore)

Year	High Rec. Area	Medium Rec. Area	Low Rec. Area
First	40	60	90
Second	40	60	90
Third	40	50	75
Fourth	40	50	70
Fifth	40	50	60

Source : Cooperative Sugar, January 1987

Table - 13

The names of Sugar Factories which have availed of benefits under the Incentive Scheme

Cooperative	Joint Stock	Public Sector	Cooperative	Joint Stock	Public Sector
(I) New Sugar Factories					
Uttar Pradesh			*25. Samrath		
1. Anoopshahr		1. Chandpur	*26. Gajanan		
2. Azamgarh		2. Chhata	*27. Khanapur		
3. Karimganj		3. Nandganj	*28. Mahakali		
4. Harduaganj		(Ghajipur)	*29. Parner		
5. Rasra		4. Nandganj	*30. Vithalwadi		
6. Nadehi		(Daryapur)	*31. Jai Jawan Jai Kisan		
7. Bilaspur			Gujrat		
8. Ramala			1. Sayan		
9. Budaun			2. Talala		
10. Bisalpur			3. Valsad		
11. Tilhar			4. Mahuva		
*12. Mahmudabad			*5. Talaje		
13. Belrayan			*6. Ukai		
*14. Gajraula			Karnataka		
*15. Sitarganj			1. Kollegal	1. Chamundeswari	1. Gangawati
16. Nanuta			2. Raibag	2. Davangere	*2. Bhadravati
*17. Sultanpur			3. Gokak		
*18. Nanpara			4. Chunchun Katte		
*19. Ghosi			5. Bhadra		
*20. Semikera			Tamil Nadu		
*21. Pooranpur			1. Tirupattur	1. Ponni	1. Tanjavur
Maharashtra			2. Vellore	2. Bannari Amman	2. Perambalur
1. Kakasaheb Wagh			3. Changalrayan		
2. Palse			4. Tiruttani		
3. Madhukar			Andhra Pradesh		
4. Belganga			1. Cuddapa		1. Miryalaguda
5. Kasoda			2. Bhimsingi		2. Hindupur
6. Kada			3. Venkateshwara		3. Muthyamnpet
7. Mula			4. Kovur		
8. Gevrai			5. Nandyal		
9. Gadhinglaj			*6. Hanuman Jn.		
10. Pathri			*7. Palair		
11. Kadwa			*8. Tenali		
12. Bhogawati			*9. Nagarjuna		
13. Godavari Mannar			Haryana		
14. Sant Eknath			*1. Sonapat		
15. Kagal			*2. Karnal		
16. Bhima Patas			*3. Shahbad		
17. Bhima Mohol			*4. Jind		
18. Purna			*5. Palwal		
*19. Ajinkyatara			Punjab		
*20. Hutatma			*1. Patiala		*1. Gurdaspur
21. Vithal			*2. Fasilka		*2. Zira
*22. Sanjay			Pondicherry		
*23. Vijaynagar			*1. Pondicherry		
*24. Shirpur					

Co-operative Joint Stock Public Sector

Madhya Pradesh

1. Barlai
- *2. Burhanpur

(II) Expansion Projects

Uttar Pradesh

- | | | |
|------------|----------------|-------------------|
| 1. Bazpur | 1. Captainganj | *1. Sakhoti Tanda |
| 2. Sarsawa | 2. Tulsipur | *2. Khadda |
| *3. Bagpat | 3. Balrampur | |
| | 4. Aira | |
| | 5. Mawana | |
| | 6. Daurala | |
| | 7. Simbhaoli | |
| | *8. Gola | |
| | 9. Deoband | |
| | 10. Dhampur | |

Bihar

1. Harinagar
2. Majhulia

Maharashtra

1. Sangli
2. Krishna
3. Pravara
3. Panchganga
5. Sangamner
6. Walwa
7. Akluj
8. Bidri
9. Datta Shirol
10. Shankar
11. Sanjivani
- *12. Kumbhi Kasari

Gujarat

1. Bardoli
2. Chalthan
3. Gandevi

Karnataka

- | | | |
|----------------|---------------|-----------|
| 1. M. K. Hubli | 1. Ugar Khurd | 1. Mandya |
| *2. Chikodi | 2. Sameerwadi | |
| | 3. Hospet | |
| | 4. Shimoga | |

Punjab

1. Morinda

Tamil Nadu

- | | | |
|-----------------|----------------|------------|
| 1. Amaravathi | 1. Aruna | *1. Madura |
| 2. Kallakurichi | 2. Nellikuppam | |
| 3. Alanganallur | | |
| 4. Salem | | |
| 5. Madurantakam | | |

Co-operative Joint Stock Public Sector

Andhra Pradesh

- | | |
|---------------|------------|
| 1. Etikoppaka | 1. Vuyyuru |
| 2. Chodavaram | 2. Tanuku |

Haryana

- | | |
|------------|----------------|
| 1. Rohtak | 1. Yamunanagar |
| 2. Panipat | |

Assam

- *1. Cachar

Rajasthan

- *1. Bhopalsagar

* Factories which are continuing to get the incentive

(III) Names of Sugar Factories which have been granted Incentives as per Court Orders

- | | |
|---------------|---------------|
| Uttar Pradesh | 1. Modi |
| | 2. Khatauli |
| | * 3. Padrauna |
| Karnataka | 1. Sirugappa |

Gujarat

1. Maroli

* Factories which are continuing to get the incentive.

AMBAJOGAI Sahakari Sakhar Karkhana Ltd.

At & Post : AMBASAKHAR 431 523
District Bid

Salient Features of the Factory :

- * Manufacturers of White Crystal Sugar from Sugarcane
- * Progressive development planned for the betterment of small and marginal farmer members and workers
- * Payment of maximum price per tonne of sugarcane
- * Leaders in imparting education
- * Promotion of Lift Irrigation Schemes for members
- * Providing facilities to educated unemployed
- * Planning for Distillery Project
- * Procurement of Government aid of Rs. 1.21 Crores for Sugarcane Development
- * Leading in distribution of aid to backward class and small and marginal farmers.

Baburaoji Adaskar
Chairman

B. S. Gaikwad
Managing Director

Gopalrao Akangire
Vice-Chairman

Table 14

State wise rate of cess or purchase tax on cane

State	(Rs. per tonne of cane)									
	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80
Andhra Pradesh	5.00	5.00	5.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Bihar	5.10	5.10	5.10	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Uttar Pradesh	5.10	5.10	5.10	6.00	10.00	10.00	12.50	12.50	12.50	12.50
Punjab	2.41	2.41	2.41	2.41	2.41	2.41	2.41	2.41	2.41	2.41
Haryana	5.00	5.10	5.10	7.00	12.50	12.50	12.50	12.50	12.50	12.50
Madhya Pradesh	from 1.4.70	3.20	from 1.5.74	26.11.74	3.20	3.20	3% on cane price + 1% on turnover tax	3% on cane price + 1% on turnover tax	3% on cane price + 1% on turnover tax	3% on cane price + 1% on turnover tax
Maharashtra	5.00	7.50	8.00	10.00	16.60	16.60	16.60	16.60	16.60	16.60
Karnataka	10% on cane price	10% on cane price	10% on cane price	10% on cane price	14.0% + 10% surcharge	16.0% + 10% surcharge	16.0% + 10% surcharge	16.0% + 10% surcharge	20% + 10% surcharge	19.2%
Kerala	5% + 5% surcharge	5% + 5% S.C.	5% + 5% S.C.	5% + 5% S.C.	5% + 5% S.C.	5% + 5% S.C.	5% + 5% S.C.	5% + 5% S.C.	5% + 5% S.C.	5% + 5%
Tamil Nadu	5.00 + 7%	5.00 + 7%	5.00 + 7%	5.00 + 7%	5.00 + 12%	5.00 + 12%	5.00 + 12.7%	5.00 + 12.7%	5.00 + 12.7%	5.00 + 12.7%
	Purchase tax 5% surcharge	P. Tax 5% S.C.	P. Tax 10% S.C.	P. Tax 10% S.C.	P. Tax 10% S.C.	P. Tax 10% S.C.	P. Tax 10% S.C.	P. Tax 10% S.C.	P. Tax 10% S.C.	P. Tax 10% S.C.

Note :— Purchase tax is levied at 6% on value of cane and 2% sales tax is levied.

of sugar produced has been collected from 1st June 1982. The cess so collected, was to be utilised for the following purposes :

(a) For making loans for facilitating the rehabilitation and modernisation of sugar factory or any unit thereof or undertaking of any scheme for development of sugarcane in the area in which any sugar factory is situated.

(b) For making grants for the purpose of any research project aimed at development of sugar industry.

(c) For defraying any other expenditure for the purpose of the Act.

15.2 The funds accumulated under this Act are to be credited to the consolidated fund of India and later utilised for the following purposes :

- (i) Loan for modernisation and rehabilitation.
- (ii) Loan for sugarcane development.
- (iii) Grants for research.
- (iv) For maintenance of buffer stocks.

For considering the applications to be received for the above purposes, the Central Government constituted a Standing Committee consisting of the following members :

- (a) Secretary, Department of Food, Chairman.
- (b) Finance Secretary, Ministry of Finance, Member.
- (c) Secretary, Department of Agriculture and Cooperation, Member.
- (d) Secretary in the Ministry of Finance (Banking Division), Member
- (e) Secretary of Planning Commission, Member.
- (f) Joint Secretary, Ministry of Finance (Banking Division), Member.
- (g) Joint Secretary, Department of Food, Member.
- (h) Joint Director, Directorate of Sugar, Department of Food, Member.
- (i) Deputy Secretary (Sugar), Department of Food, Secretary.

15.3 According to the Rules formulated for the utilisation of the Fund, for the purposes indicated, the Committee is expected to receive applications and scrutinize them before granting of loan.

15.4 For rehabilitation and modernisation purpose, a sugar undertaking which will be provided a financial institution for assistance under its relevant scheme for modernisation and rehabilitation of its plant and machinery, the factory shall normally be eligible for loan under this scheme.

15.5 For granting of loan for sugarcane development, the Act provides sanction to the payment of loans from the Fund to sugar undertakings in connection with the development of sugarcane in its area for

the purpose of :

- (i) Setting up of heat treatment plant
- (ii) Rearing nursery
- (iii) Pest control measures
- (iv) Incentives to cultivators to switch over to important varieties of sugarcane
- (v) Irrigation schemes; and
- (vi) Any other scheme or project as may be approved by the Central Government.

15.6 For grant of funds for research, the Committee is authorised for payment of grants to established institutions connected with sugar industry for carrying out research aimed at the promotion and development of any aspects of sugar industry, provided with the research schemes or recommended by the Development Council for the sugar industry.

15.7 For the maintenance of buffer stock (see below) by the sugar factories, the fund accumulated under the Act could be utilised as subsidy to be given to the factories. The subsidy for quarterly period or part thereof payable to the factories is computed in accordance with the following formula :

- (a) Subsidy towards interest (Rs.)
- $$B \times V \times I \times \frac{N}{365/366}$$
- (b) Subsidy towards storage and insurance charges
- $$B \times V \times S \times \frac{N}{365/366}$$
- Total of (a) & (b)

Where, B, is the quantity in quintals of sugar maintained as buffer stock.

V, is the value for quintal of sugar.

I, is the rate of interest

S, is the rate of storage and insurance charges &

N, is the number of days for which the quantity of buffer stock is maintained under the relevant period/quarter divided by 366 days in leap year and by 365 days in other years.

15.8 As a result of the commendable efforts/steps that have been taken or contemplated by Government of India for developing the sugar industry during the last 4/5 decades, it is indeed gratifying to note that the sugar industry has made, as mentioned earlier, rapid strides of progress particularly in the cooperative sector of sugar industry.

16. Buffer Stock

16.1 As mentioned earlier, the sugar industry in India has been facing varied degrees of fortunes during the last 4 decades. In some years there is excess production, due to large quantities of cane available. The factories had to operate even in summer months, June and July, when the recoveries are too low to enable

factories to operate economically. In these years, there is no space even to store sugar in the factory premises. In other lean years, sugar factories procure too small quantities of cane to operate economically; factories operate for periods of 90-100 days only. Production of sugar falls down substantially. The sale-price of sugar goes up beyond Rs.10/- per kg. The consumer is affected considerably. In order to stabilise the supply of sugar to the consumer at a reasonable price, there have been suggestions that the Government of India should adopt a system of maintaining a buffer stock of sugar. The Sen Commission and the Bhargava Commission had stated that maintenance of buffer stock would, to some extent, even cut the fluctuations of sugar prices. Government of India could not act for long time, on this suggestion primarily on account of scarcity of funds to meet the interest and storage charges on the stock of sugar. Nevertheless, the Government of India had announced in 1982 their decision to create a buffer stock of 5 lakh tonnes. The finances for the same are to be made available from the funds of Sugar Industry Development Fund.

17. Agencies for Sugarcane Development

17.1 The main agencies for carrying work relating to cane development in the country is Sugarcane Development Council constituted under the provisions of the Industries (Development & Regulation) Act, 1951. Under the aegis of the Sugarcane Development Council and Government of India's various schemes, the programme of cane development is chalked out by sugar factories and Government Departments, cane grower unions and cane development council in sugar factory areas. Pattern of organisation differs from State to State; in some States, for example, U. P., there is a separate department for cane development, while in other States such as Tamil Nadu, Bihar, Maharashtra, Karnataka, etc., the Department of Agriculture looks after the over all development of sugarcane along with other agricultural crops. In States like Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu, factories deal directly with cane growers for cane development, while in other States such as U. P. and Bihar, the factories deal mostly with the cane grower unions instead of individual cane growers. Apart from Government departments, factories and cane grower unions and also statutorily appointed cane development councils in certain States are carrying out the cane development activities. The cane development council for a factory area is constituted under the provisions of the relevant State Sugarcane Act and Rules. The Council generally consists of representatives of cane growers, cane grower society/union, sugar factory and State Government officials.

The Chairman of the Council is nominated by Cane Commissioner/Sugar Commissioner/Government officials act as Secretary/Joint Secretary of the Council. The Council draws up and executes schemes for cane development.

17.2 The centrally sponsored schemes of sugarcane development operate in different States with the main objectives to demonstrate the utility of proper development activities around the sugar factory area for increasing the production of sugarcane. The programme generally includes :

- (a) Quality seed production and distribution for commercial cultivation.
- (b) Demonstration of improved agricultural practices for plant and ratoon crops to overcome constraints obtaining in different units.
- (c) Training of sugarcane development workers at State level.
- (d) Assistance for timely plant protection measures and
- (e) Construction of link roads around sugar factories.

17.3 To meet the expenses for development programmes, the Government of India permits collection of sugarcane cess/commission or cane purchase tax, which is generally included in the cost of production of sugar. The purchase tax on cane and cess differs from State to State.

17.4 Table 14 indicates the State-wise rate of cess or purchase tax on cane.

17.5 By way of the above cane cess/purchase tax, different States collected varied amounts of fund and spent on cane development. Table 15 gives the data on the State-wise amount of cane cess/purchase tax and spent on cane development in the years 1970 to 1980-81.

17.5 It may be noted that while large amounts of purchase tax/cane cess were being collected, very little is being spent actually on cane development. In view of the inadequate efforts on development of cane by the State Governments and factories, the Government of India recently instituted Sugar Cess Act, 1982 to provide adequate funds and to take regulative and stringent measures for sugarcane development.

18. Export of Sugar

18.1 India's production of sugar is about 7 to 10% of the world sugar production (96 million tonnes in 1981-82) from both sugarcane and sugar beet. For the first time, India entered into export market in 1956-57, when the world sugar production was low and there was considerable demand of sugar in the world market. Primarily the export of sugar is governed by the Inter-

national Sugar Agreement (ISA) of 1973, which operates under overall supervision of the Secretary General, United Nations. The following statement indicates the list of Exporting and Importing countries and territories (and allocation of votes for each country/territory) who are members of the International Sugar Agreement.

List of Exporting & Importing Countries and Territories and Allocation of Votes for the purpose of Article 75

EXPORTERS

Argentina	24
Australia	81
Austria	6
Bangladesh	5
Barbados	5
Belize	5
Guyana	7
Jamaica	7
St. Kitts-Nevis-Anguilla	5
Trinidad and Tobago	5
Bolivia	5
Brazil	112
Colombia	11
Congo	5
Costa Rica	5
Cuba	118
Czechoslovakia	11
Dominican Republic	36
Ecuador	5
El Salvador	6
Ethiopia	5
European Economic Community	124
Fiji	6
Guatemala	11
Haiti	5
Honduras	5
Hungary	5
India	63
Indonesia	10
Madagascar	5
Malawi	5
Mauritius	12
Mexico	27
Mozambique	5
Nicaragua	5
Pakistan	6
Panama	5
Paraguay	5
Peru	17
Philippines	58
Poland	22

Romania	5
South Africa	38
Sudan	5
Swaziland	5
Thailand	39
Turkey	5
Uganda	5
United Republic of Cameroon	5
United Republic of Tanzania	5
Uruguay	5
Venezuela	5
Zambia	5

TOTAL 1000

IMPORTERS

Algeria	27
Bulgaria	12
Canada	66
Chile	9
Egypt	12
Finland	9
German Democratic Republic	5
Ghana	5
Iraq	25
Israel	11
Ivory Coast	5
Japan	184
Kenya	5
Libyan Arab Jamahuriya	8
Malaysia	23
Morocco	19
New Zealand	12
Nigeria	10
Norway	10
Portugal	21
Republic of Korea	16
Singapore	5
Somalia	5
Spain	24
Sri Lanka	5
Sweden	6
Switzerland	14
Syrian Arab Republic	13
Tunisia	11
Union of Soviet Socialist Republics	105
United States of America	297
Upper Volta	5
Yugoslavia	11
Zaire	5

TOTAL 1000

Table 15

State-wise amount of cane cess / purchase tax collected and spent on cane development.

(Rs. in lakhs)

State	1960/61	55/66	69/70	70/71	71/72	72/73	73/74	74/75	75/76	76/77	77/78	78/79	79/80
Andhra Pradesh	65 (28)	102 (51)	144 (59)	97 (51)	162 (65)	172 (64)	261 (48)	N.A. (N.A.)	412 (22)	285 (38)	313 (36)	250 (56)	281 (140)
Bihar	84 (23)	170 (24)	164 (41)	198 (46)	217 (52)	218 (35)	215 (34)	251 (43)	220 (97)	249 (108)	312 (113)	291 (132)	181 (130)
U. P.	426 (89)	683 (115)	590 (181)	679 (164)	461 (210)	624 (362)	706 (277)	880 (373)	1253 (216)	1201 (N.A.)	1526 (411)	1398 (92)	1787 (857)
Punjab	14 (9)	15 (N.A.)	N.A. (5)	13 (2)	8 (N.A.)	7 (N.A.)	N.A. (N.A.)	N.A. (N.A.)	N.A. (N.A.)	N.A. (N.A.)	N.A. (N.A.)	24 (33)	N.A. (N.A.)
Haryana	—	—	16 (7)	38 (8)	49 (3)	53 (N.A.)	62 (4)	107 (44)	124 (36)	141 (14)	N.A. (N.A.)	47 (2)	229 (183)
Maharashtra	133 (6)	232 (16)	414 (34)	454 (12)	542 (32)	786 (33)	725 (33)	993 (N.A.)	1712 (N.A.)	1781 (36)	N.A. (N.A.)	N.A. (N.A.)	2255 (N.A.)
Karnataka	N.A. (N.A.)	119 (3)	152 (5)	163 (6)	184 (14)	N.A. (N.A.)	290 (N.A.)	428 (7)	N.A. (N.A.)	N.A. (N.A.)	N.A. (N.A.)	2956 (18)	232 (15)
Tamilnadu	21 (15)	76 (27)	250 (50)	209 (56)	284 (57)	N.A. (N.A.)	N.A. (N.A.)	292 (60)	375 (110)	465 (120)	126.4 (148.4)	596 (110)	36 (150)
M. P.									17	15	8	N.A.	11

Note : 1. Figures given in the brackets show amounts on cane development.

2. Purchase tax collection figures not available.

Table 16

Year - Wise Export of Sugar From India

Year	Quantity Exported (Lakh tonnes)		
1957	1.47	1971	3.32
1958	0.50	1972	0.99
1959	0.16	1973	2.49
1960	0.18	1974	4.43
1961	2.68	1975	9.66
1962	3.73	1976	8.43
1963	4.79	1977	2.54
1964	2.34	1978	6.35
		1979	6.56
1965	2.67	1980	0.64
1966	4.41	1981	0.98
1967	2.17	1982	4.66
1968	0.99	1983	7.24
1969	0.94	1984	2.84
1970	3.18	1985	0.39

It may be noted that the exporting members together hold 1000 votes and the importing members together have 1000 votes.

18.2 The votes of the importing members are distributed among them in proportion to their net imports from the free market and under special arrangements calculated according to the following terms :

- (a) Each importing member shall have that portion of 900 votes which its average annual net imports from the free market over the preceding four years, disregarding the year of its lowest imports from the free market, bear to the total of such average imports from the free market of all importing members.
- (b) Each importing member shall have that portion of 100 votes which its imports under special arrangement for the preceding year bear to the total imports under special arrangements of all importing members for the preceding year.

18.3 The main objectives of the International Sugar Agreement are as follows :

- (a) To raise the level of international trade in sugar particularly to increase the export earnings of developing countries.
- (b) To achieve stable conditions in the international trade in sugar, including avoidance of excessive price fluctuations.
- (c) To provide adequate supplies of sugar to meet the requirements of importing countries at fair and reasonable prices.
- (d) To increase sugar consumption and in particular to promote measures to encourage consumption in countries where per capita consumption is low.
- (e) To promote equilibrium between supply of and demand for, sugar within an expanding world of sugar trade.
- (f) To facilitate the co-ordination of sugar marketing policies and the organisation of the market.
- (g) To provide for adequate participation in, and growing access to the markets of the developed countries for sugar from the developing countries.
- (h) To assess closely developments in the use of any form of substitutes for the sugar including cyclamates and other artificial sweeteners and
- (i) To further international cooperation in sugar questions.

18.4 The importing and exporting countries meet periodically in different places like Geneva, London, New York, etc. and discuss various policies relating to international sugar trade. The decisions are governed

by voice of vote, the votes being reckoned on the basis of their allocation to different countries as indicated above.

18.5 The total 1000 votes of exporting members shall be distributed among them prorata to the weighted average of the following factors :

- (a) Their basic export tonnage or export entitlements as appropriate ... 50 per cent
- (b) Their total net exports
 - (i) To the free market ... 18 per cent
 - (ii) Under special arrangement ... 7 per cent
- (c) Their total production ... 25 per cent

18.6 In the early years when India started exporting sugar the importing countries demanded that the sugar to be exported should be of raw sugar of 97-98 pol percent, instead of the plantation white sugar that is generally manufactured in India. The sugar factories in India had therefore, to modify the process of manufacture and put in maximum efforts for production of raw sugar. While number of difficulties were experienced initially by factories, the National Sugar Institute had demonstrated the process of manufacture of raw sugar in its Experiment Sugar Factory at Kanpur. When the procedures were followed by all the factories, it was gratifying to point out that Indian raw sugars were acclaimed to be one of the best in the world. Subsequently, the laws relating to import of sugar in U.S.S.R., U.K., Canada and Japan, which earlier purchased only raw sugar, were modified permitting import of plantation white sugar of 99.5 pol max. Then the same was treated in the importing countries, as raw sugar for all purposes and was melted and reprocessed for manufacture of refined sugar.

Table 16 gives the year-wise export of sugar from India.

18.7 In the years 1980 and 1981, India's performance in respect of export of sugar had not been satisfactory. During 1980-81, the performance was poor as India did not have enough sugar for export after meeting the domestic requirements. In fact, India had to import 1.80 lakh tonnes in 1980-81. During 1982, however, due to record production of nearly 84.5 lakh tonnes during 1981-82, India acquired export quota of 6.5 lakh tonnes. In view of the comfortable position of sugar stocks in the country in the sugar year 1982-83, Government of India had exported 7.24 lakh tonnes in the year 1983. Efforts were made to export in 1984 upto 10 lakh tonnes of sugar.

Table 17 gives the names of countries to which India exported sugar in the last 10 years.

18.8. The Government of India in the Ministry of Food

Table - 17

COUNTRY WISE EXPORT OF SUGAR FROM INDIA

Country	1977	1978	1979	1980	1981	1982	1983	1984	1985	(In tonnes)	
										1986(Pro)	
Afghanistan	—	10000	—	—	—	—	—	—	—	—	—
Bangladesh	—	—	16450	10000	—	—	—	36800	—	—	—
Somalia	—	—	21350	—	—	—	—	17400	—	—	—
Egypt	19782	43500	80900	11550	—	26950	280046	47500	—	—	—
China	—	71150	20500	—	—	85900	11000	—	—	—	—
Djibouti	—	1300	—	—	—	—	—	—	—	—	—
Indonesia	98470	253297	191303	—	84000	278742	27000	—	—	—	—
Italy	—	—	—	—	—	—	—	10000	—	—	—
Kenya	4850	—	41250	—	—	—	—	—	—	—	—
Maldives	1050	2400	5175	—	—	1000	1900	1500	1,000	830	—
Morocco	—	—	—	—	—	—	53800	15550	10,723	13,699	—
Nepal	—	—	—	1500	—	—	—	—	—	—	—
N. Korea	—	30800	—	5220	—	—	—	—	—	—	—
Oman	250	—	—	—	—	—	—	—	—	—	—
Saudi Arabia	—	—	—	—	—	—	—	10500	—	—	—
Sri Lanka	27530	85150	222050	—	14000	40808	172400	126873	—	—	—
Sudan	19550	70000	12000	11500	—	13200	35600	—	—	—	—
Sechelleys	800	—	—	—	—	—	—	—	—	—	—
Tunisia	—	—	—	—	—	—	35100	—	—	—	—
Tanzania	19400	—	—	—	—	—	—	—	—	—	—
U.K.	27120	23800	25476	24441	—	—	—	—	10,000	10,000	—
U.S.A.	—	—	—	—	—	19625	20100	—	17,700	11,800	—
Yemen	36000	34000	—	—	—	—	—	—	—	—	—
Pakistan	—	—	19600	—	—	—	—	—	—	—	—
Lebanon	—	—	—	—	—	303 (Gift)	—	—	—	—	—
Y.A.R	—	—	—	—	—	—	67200	18000	—	—	—
Ecuador	—	—	—	—	—	—	10238	—	—	—	—
U.A.R.	—	10300	—	—	—	—	—	—	—	—	—
Kuwait	—	—	—	—	—	—	—	3(In Satches)	—	—	—
TOTALs	254802	635697	656054	64241	98000	466528	724384	284126	39423	36,329	—

and Agriculture, in the Ministry of Finance and the Ministry of Civil Supplies, govern the policies relating to the export of sugar. It generally works under the provisions of Sugar Export Promotion Act, 1958. According to the provisions of this Act, the quantity of sugar to be exported in a year is proportioned to the production of factories. The Indian Sugar Industry Export Corporation, is an organisation of the joint stock and cooperative sector of the industry and is specified as the Export Agency under this Act, to handle sugar exports on behalf of Government. It makes payment to factories for the sugar delivered by them at their quotas. The total sugar receipts are worked out, from which the expenditure incurred by the Export Agency is deducted, and the balance is distributed among the factories in proportion to the quota delivered by them.

18.9 From 1973-74, the sugar exports are canalised through State Trading Corporation of India Ltd. (STC). The Indian Sugar Industry Export Corporation Ltd. acts as the agent for physical handling of sugar for export, on behalf of STC. In view of the large stocks of sugar existing in the country, Government of India is making efforts to export not only the ISA quota of 6.5 lakh tonnes but also about 3.4 lakh tonnes of sugar in other markets.

18.10 The foreign exchange earned by export of sugar depends on the international market. In some years the international prices were as high as £403 per tonne (London Daily Price - maximum in 1980). They were of the order of £350 per tonne in 1973-74. India earned as much as 440.2 crores of foreign exchange from sugar exports in 1974. The earnings in the year 1983 have also been substantial, about Rs.150 crores.

19. Manufacture of Beet Sugar in India

19.1 Sugar beet is used as raw material for manufacture of sugar, in a number of countries having cool climate such as European countries, Canada, Russia, etc. Sugar beet is a crop of temperate region. Normally seeds are sown during March/April and the crops are ready for harvesting during October to December. Sugar beet crop requires a fairly cool climate—mean temperature of about 23°C, good rainfall and irrigation during the growing period, accompanied by bright sun shines which helps growth of the root considerably. Sugar beet grows in loamy and clay-loamy soils, but it also grows well in sandy loamy and clay. The crop can tolerate fairly high salt content and alkaline soil. However, best crops are obtained on neutral soils. The world production of sugar from sugar beet ranges from 30 to 25 million tonnes (see Table 18).

19.2 About 45 countries in the world produce sugarbeet. These countries are mainly situated in Europe, North America, West Asia. Though sugarbeet is consi-

dered as a crop of temperate region, its cultivation is spreading to subtropical tracts. Sugarbeet was introduced as early as in 1914 in India at Indore and subsequently in few other places. However, systematic studies in different aspects of beet were initiated by the Indian Council of Agricultural Research in 1959 primarily with the object of increasing the duration of the crushing season and the recovery in a few States in India, particularly Punjab, Haryana, Rajasthan, etc. where the recoveries of sugar from cane are rather low. The work was taken up as a co-ordinated project by Indian Institute of Sugarcane Research at Lucknow and the National Sugar Institute at Kanpur. The sugarbeet was harvested after a period of 4 months of crop which gave an yield of 16.4 tonnes of roots per hectare. In 1960-61, the cultivation of sugarbeet was extended to certain sugarcane research stations and agricultural farms in States to get an estimate of the yield and quality of the crop and its suitability to conditions prevailing in various parts of India. Cultivation of sugarbeet was initiated in 1964 at the G. B. Pant University of Agriculture & Technology, Pantnagar, U. P. also. The cultivation tests, therefore had a wide coverage. The sugarbeet seeds used in these experiments were imported from Denmark, the Federal Republic of Germany, the German Democratic Republic, the U.S.A. and the U.S.S.R.

19.3 The results obtained in different locations of our country are given in Table 19.

The average sugar (pol) % beetroots obtained in these countries is 16 to 18%, when compared with 12-16% pol in beet grown in India.

19.5 On the basis of the experiments conducted in different parts of India on the cultivation of sugarbeet it has now been established that sugarbeet can be successfully cultivated as a winter crop in the irrigated plains of Punjab, Haryana, Rajasthan and West U.P.; and the yield of beetroots is expected to be of the order of 45-50 tonnes per hectare with a sugar content 14-1/2 - 16%, on an average. It has also been established that the best time of sowing beet seed in India is early October and the crop would be ready in a period of six months for harvesting, that is, by the end of March to end of May. This also synchronises generally with the closure of the sugarcane crushing season during the normal years of cane production.

19.6 During the last 15 years, over 50 varieties of sugarbeet seeds have been imported from different countries into India and tested under the Indian conditions. Of these, Ero Type E (West German Origin), US 35 and 75 (both American origin), Romonskay (Russian origin), Maribo Anglo Poly, Maribo Resista Poly and Maribo Magna Poly (all of Danish origin) have

Table 18
Total World Sugar Production

Countries	Total
Beet Sugar	
West Europe	16508
East Europe	13877
Other Countries	
Afghanistan	12
Algeria	8
Azores	9
Canada	139
Chile	132
China	290
Iran	580
Iraq	13
Israel	37
Japan	364
Lebanon	14
Morocco	225
Pakistan	31
Syria	21
Tunisia	11
Uruguay	55
USA	2820
World Beet Sugar	35146
Cane Sugar	
Europe	15
North & Central America	16682
South America Argentina	1666
Bolivia	284
Brazil	8760
Colombia 2)	1014
Ecuador	281

('000 MT; raw value)

Countries	Total
Guayana 2)	342
Paraguay	53
Peru	856
Surinam	9
Uruguay	58
Venezuela	402
Africa	5887
Asia Bangladesh	191
Burma	39
China	2030
India	7000
Indonesia	1261
Iran	107
Iraq	20
Japan	279
Malaysia	80
Nepal	29
Pakistan	907
Philippines	2387
Sri Lanka	25
Taiwan	767
Thailand	1624
Vietnam	33
Oceania Australia	3440
Fiji	376
World Cane Sugar Total	56904
World Beet Sugar Total	35146
World Sugar Production	92050

Table 19
Yields of Sugarbeet Obtained
at Different Locations

Location of experiment stations		Yield of	Pol %
Place	tate	Roots	Roots
		(Tonnes/ Hectare)	
Jullundur	Punjab	32.7	16.3
Karnal	Haryana	46.8	14.8
Muzaffarnagar	U. P.	36.1	15.6
Shahjahanpur	U. P.	26.6	14.9
Lucknow	U. P.	26.1	18.5
Pusa	Bihar	67.7	14.7
Mandya	Karnataka	22.3	12.0
Pantnagar	U. P.	65.12	15.5

19.4 For purposes of comparison, the yields of sugarbeet in other countries are given in Table 20.

Table 20
Yields of Sugarbeet in Other Countries
(Tonnes/Hectare)

	1969-71	1979	1980	1981
Belgium	51.50	58.84	50.58	59.26
Israle	47.68	49.39	-	49.06
Netherland	48.04	44.44	49.16	54.46
Switzerland	46.18	57.08	50.48	66.32
Germany (Federal)	45.50	46.63	48.37	54.20
Germany (Democratic Republic)	27.12	26.34	28.10	30.11
U. K.	36.27	35.76	34.86	36.02
Denmark	39.83	39.69	39.60	39.20
U. S. S. R.	22.07	20.44	21.44	16.68
U. S. A.	42.38	44.04	44.41	42.71
Europe (Average)	35.99	39.05	38.32	42.64
Wrold (Average)	29.30	29.80	29.28	30.12

been found to give the best results under the Indian conditions.

19.7 A normal beet plant produces its blossoms in clusters. Each cluster results in a seed ball containing several seeds held closely together in a cork like material. In the earlier days, the whole seed ball was producing a number of plants close together requiring laborious thinning operations by hand. In the later stages, it was found that the seed should be processed by reducing, by mechanical means, the number of seeds in a seed ball, and this resulted in the development of beet plant that can produce only a single seed in each seed ball (mono germ seed). By this, the quantity of seed required per acre could be reduced substantially.

19.8 In India, about 10 kgs. of unprocessed seed per hectare are found to give satisfactory sugarbeet crop, though in other countries a higher quantity of seed upto 25 kgs. per hectare is used.

19.9 The production of sugarbeet seed from the imported varieties and its multiplication and processing of seed is being undertaken in India by the National Seeds Corporation, New Delhi. They have seed nurseries in Kalpa Valley of Himachal Pradesh and in Jammu & Kashmir valley. The seeds suitable for any particular area can be obtained from the above Corporation.

19.10 Cultivation of sugarbeet on commercial scale by some of the sugar factories located in suitable regions and manufacture of sugar from sugarbeet has many advantages, some of which are mentioned below :

(a) Sugarbeet crop is a 6-7 months crop and yields 30-50 tonnes of roots per hectare with a sugar content of 15-16% on the average, under Indian conditions. Thus sugarbeet can yield nearly as much sugar as a 12 month sugarcane crop can yield in the States of Haryana, Punjab, Rajasthan and U. P.

(b) Due to higher percentage of sugar in sugarbeet as compared to sugarcane, the yield of sugar per hectare by cultivation of sugarbeet is more than that obtained in the case of sugarcane.

(c) By cultivation of sugarbeet, the field is occupied for a period of only 6-7 months and during the rest of the period any kharif crop can be raised in temperate and sub-tropical parts of North, Central and South India, thereby increasing the return to the growers.

(d) Sugarcane and sugarbeet can be grown very successfully, as companion crops for obtaining higher production of raw material for sugar industry per unit area which lowers cost of production.

(e) Under Indian climatic conditions, sugarbeet is a winter crop i.e. normally the seeds are sown in October

and the crop is ready for harvesting in April/May, by which time the cane crushing is over in normal years. Therefore, by processing sugarbeet for a period of about 60 days after the sugarcane season is over, it would result in the reduction of overall expenses, increase in the employment period of workers apart from increasing the production of sugar in the country.

(f) Sugarbeet can thrive very well in soils with as high as 9.5 pH and thus several hundred acres of alkaline soils in U. P., Punjab and Haryana which are otherwise not suitable for cultivation of any crop can be used for the cultivation of sugarbeet successfully and thereafter such lands can be used for cultivation of other crops. Thus, sugarbeet crop works as a scavenger of salinity of the soils.

(g) Sugarbeet has a high tolerance to frost and cold, which are at present prevalent in northern Indian States and which are not conducive to the growth of sugarcane and, therefore, sugarbeet can be successfully grown in such areas as compared to sugarcane.

(h) Sugarbeet, being a deep rooted crop, it fits very well in the crop rotation and improves the general productivity of land.

(i) Sugarbeet tops are valuable feed for all ruminant livestock.

(j) The dry beet pulp contains 60% carbohydrates 5% crude protein and, therefore, it is a good cattle feed either by itself or mixed with molasses.

(k) Molasses obtained by the processing of sugarbeet is a rich source of Vitamin B and is, therefore, a valuable raw material in the pharmaceutical industry.

19.11 Cultivation of sugarbeet on commercial scale and manufacturing sugar from sugarbeet in India have met with problems which are briefly noted below :

(a) Unlike sugarcane, which is used in the manufacture of gur and khandsari and for chewing purposes, sugarbeet can only be used in the manufacture of sugar. Therefore, any scheme for cultivation of sugarbeet on commercial scale should be associated with a scheme for processing sugarbeet into sugar otherwise sugarbeet will be wasted. Therefore, cultivation of sugarbeet and manufacturing sugar from sugarbeet are interconnected.

(b) For economic processing of sugarbeet in a factory, at least 60,000 tonnes of beet roots should be available and under the conditions existing in India, the area to be brought under sugarbeet cultivation would be to the extent of 3000 hectares and a large number of growers will have to be induced to take up cultivation of sugarbeet by assuring an attractive price for their produce and other assistance by way of supply of inputs, credit facilities, etc.

STATE-WISE NUMBER OF SUGAR FACTORIES IN OPERATION IN INDIA

State	1976-77 Coop. TI	1977-78 Coop. TI	1978-79 Coop. TI	1979-80 Coop. TI	1980-81 Coop. TI	1981-82 Coop. TI	1982-83 Coop. TI	1983-84 Coop. TI	1984-85 Coop. TI	1985-86* Coop. TI										
1. Andhra Pradesh*	11	22	12	23	13	26	13	26	13	27	14	28	15	28	18	31	17	30	18	31
2. Assam	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
South Bihar	—	3	—	3	—	3	—	3	—	3	—	3	—	3	—	3	—	3	—	3
North Bihar	—	24	—	25	—	25	—	25	—	25	—	25	—	25	—	25	—	25	—	25
3. Bihar (Total)	—	27	—	28	—	28	—	28	—	28	—	28	—	28	—	28	—	28	—	28
4. Goa	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5. Gujarat	10	10	11	11	13	13	11	11	13	13	14	14	15	15	12	12	12	12	13	13
6. Haryana	4	5	4	5	4	5	4	5	4	5	4	5	4	5	4	5	4	5	4	5
7. Karnataka	9	19	11	21	11	21	13	23	13	23	13	23	13	23	13	24	14	24	13	22
8. Kerala	2	3	2	3	2	3	2	3	2	3	2	3	2	3	1	2	1	2	1	2
9. Madhya Pradesh	1	6	1	6	1	6	1	6	2	7	2	7	2	7	3	8	3	8	3	8
10. Maharashtra	51	61	56	66	59	69	60	70	67	77	67	78	67	78	67	78	77	87	80	88
11. Nagaland	—	1	—	1	—	1	—	1	—	1	—	1	—	1	—	1	—	1	—	1
12. Orissa	2	3	2	3	2	3	2	3	1	2	2	3	2	3	2	3	2	3	2	3
13. Punjab	4	6	4	6	4	6	4	6	4	8	4	8	4	8	4	8	4	8	6	9
14. Pondicherry	—	1	—	1	—	1	—	1	—	1	—	1	—	1	—	1	—	1	—	1
15. Rajasthan	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3
16. Tamil Nadu	9	19	9	20	9	20	9	20	10	21	10	21	10	21	11	23	11	23	11	24
East U.P.	3	35	3	36	3	37	3	37	3	37	3	37	4	37	7	41	3	35	7	41
West U.P.	3	20	4	22	5	23	6	23	6	24	6	24	6	23	6	24	7	25	6	24
Central U.P.	4	24	7	28	7	29	7	29	8	30	9	31	10	31	11	32	12	32	15	35
17. U.P. (Total)	10	79	14	85	15	88	16	89	17	91	18	92	19	91	21	93	26	98	28	100
18. West Bengal	—	2	—	2	—	2	—	2	—	2	—	2	—	2	—	2	—	2	—	2
ALL INDIA	116	270	129	287	136	298	138	300	149	315	153	320	156	320	160	325	178	338	186	341

•Two plants of Nizam (Shakarnagar) are taken as one factory.

@ 3 Cooperative Sugar Factories of Bihar are taken over by State Government.

(c) Sugarbeet processing requires special equipment like the beet slicers, beet washers, diffusion plant, dewatering equipment etc. The cost of this equipment for a plant having a capacity of 1000 tonnes beet processing per day would be about Rs. 150 lakhs.

(d) Sugarbeet juice cannot be efficiently clarified by adopting the double sulphitation process. Adoption of double carbonation process is essential for good clarification. Therefore, in the case of sulphitation factories, additional equipment will have to be installed for adopting carbonation process and this may cost about Rs. 50 lakhs per factory.

(e) Unlike sugarcane, which yields a by-product viz. bagasse, which is ready fuel in the factory, sugarbeet processing requires the use of extra fuel like coal, firewood etc., which increases the cost of production.

(f) The success of the beet sugar industry very much depends on the availability of best variety of seed capable of yielding high tonnage with high percentage of sugar and good processing qualities. Therefore, strenuous efforts are necessary for the production of entire quantity of required commercial seed from domestic breeding centres.

19.12 The commercial-scale sugarcane-cum-sugarbeet plant having a daily cane crushing capacity of 1200 tonnes and beet processing capacity of 600 tonnes has been established at the Ganganagar Sugar Mills Ltd., Sriganganagar (Rajasthan) making use of a DDS type of diffusion plant. The plant went into production in 1971-72 crushing season. With the advent of commendable cane variety CoJ 64 which has helped considerably in sugar industry in Punjab and Haryana, the beet crop has not taken root in these States.

20. Sugar Factories in Different Sectors

20.1 Most of the factories operating in India before 1952 have been of private or joint stock sector. Out of 139, only about 4 factories - one at Mandya in Karnataka, another factory at Guraru in Bihar, the third at Ganganagar in Rajasthan and the fourth at Bodhan in Andhra Pradesh, belong to State Governments. One factory in Ettikopaka in Andhra Pradesh has been operating as a cooperative factory since 1930s. Ever since, the ideology of building up cooperative sector as an integral part of economic planning in India has been advocated in all the Five Year Plans and ever since the same has been spelt out in the Industrial Policy Resolutions following enactment of Industrial (Development and Regulation) Act, 1951, great impetus has been given to the establishment of sugar industry in the cooperative sector with the main objective being:

(a) To secure increase in production and its equitable distribution.

- (b) To distribute equally, grains of productivity among cane growers, workers and consumers.
- (c) To create a sense of mutual obligation and concern for rehabilitation of the weaker sections of the community including labour, both agriculture and industry.
- (d) To eliminate exploitation of workers and to provide amenities and facilities for their better living.
- (e) To establish and maintain intimate relationship between the management and individual families associated with the cooperative factories.
- (f) To provide opportunities to the rural community for gainful employment and improving standards and working conditions.
- (g) To organise and render various services to the members of cooperative factories for their socio-economic betterment.
- (h) To eliminate concentration of economic power in a few hands.
- (i) To develop and improve sugarcane cultivation in particular and agriculture in general, and
- (j) To achieve results valuable to the community by drawing equal upon incentives which are social and incentives which are individual.

20.2 In order to promote setting up of a cooperative factories to achieve the above objectives, a scheme of financing cooperative sugar factories was evolved under which the State Government participates in the share capital of cooperative factories and the Central and State Governments are to guarantee loans advanced to the factory by the long term loan financial institutions like Industrial Financial Corporation, Life Insurance Corporation, etc.

20.3 To enable the State Governments to participate in the share capital, National Cooperative Development Corporation advances loans to them, out of the funds placed at its disposal by the Central Government.

20.4 Financial requirements for achieving the targets
Pattern of financing a new Cooperative Sugar Factory is as follows :

	<u>Rs. in Lakhs</u>
(a) Total estimated project cost	950
(b) Members' Share Capital contribution 10% of the project cost	95
(c) State Government's share capital contribution, 25% of the project cost	240
(d) Term loan from Central Financing Institutions 65%	615

Table - 22

STATEWISE DURATION OF CRUSHING SEASONS IN INDIA

State	(In Days)											
	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86*		
	Coop. TI	Coop. TI	Coop. TI	Coop. TI	Coop. TI	Coop. TI	Coop. TI	Coop. TI	Coop. TI	Coop. TI		
1. Andhra Pradesh	96	90	155	141	87	89	48	55	64	73	144	148
2. Assam	102	102	99	54	137	87	94	64	56	46	115	88
South Bihar	—	49	—	61	—	49	—	18	—	35	—	96
North Bihar	—	78	—	110	—	107	—	64	—	72	—	130
3. Bihar (Average)	—	75	—	104	—	101	—	59	—	68	—	126
4. Goa	77	77	100	100	88	88	75	75	57	57	109	109
5. Gujarat	123	123	174	174	136	136	110	110	135	135	194	194
6. Haryana	120	136	173	179	135	149	68	82	85	99	175	183
7. Karnataka	141	135	191	185	144	143	82	82	97	99	169	167
8. Kerala	94	81	122	107	126	120	78	79	81	75	87	78
9. Madhya Pradesh	79	92	125	150	85	134	18	49	38	38	112	108
10. Maharashtra	150	145	182	181	176	177	112	111	146	145	202	203
11. Nagaland	—	85	—	106	—	133	—	102	—	62	—	90
12. Orissa	60	49	94	98	122	102	54	45	98	60	106	103
13. Punjab	154	151	191	187	174	173	79	75	77	63	176	174
14. Pondicherry	—	198	—	163	—	181	—	127	—	157	—	181
15. Rajasthan	100	125	201	183	100	130	19	54	40	54	70	92
16. Tamil Nadu	158	142	184	170	187	176	111	122	121	142	214	223
East U.P.	94	112	103	149	78	116	29	74	34	74	116	149
West U.P.	159	157	194	205	131	135	84	90	104	109	200	187
Central U.P.	165	155	183	211	147	158	93	89	110	115	196	198
17. U.P. (Average)	137	137	168	180	128	134	77	83	95	97	184	176
18. West Bengal	—	83	—	106	—	81	—	28	—	33	—	79
ALL INDIA	136	125	174	165	151	140	94	86	118	104	185	173
											115	111
											120	106
											120	120
											116	116

•Provisional

The National Cooperative Development Corporation (NCDC) contributes 50% of the State share capital contribution in normal area and 65% in industrially backward areas over and above the minimum State Share Capital contribution of Rs.70 lakhs per factory i.e. nearly Rs.52.5 lakhs for normal areas and Rs.68.25 lakhs for backward area, the average being Rs.60 lakhs per factory. This assessment is based on the project cost of Rs.700 lakhs. But on account of escalations in the project cost, these will proportionally increase.

20.5 As a result of the considerable assistance and encouragement provided by the Government, the number of cooperative factories in the country increased considerably since 1956, particularly in the States like Maharashtra, Gujarat, Tamil Nadu, Punjab, Haryana and U. P. In some States or regions where a cooperative factory could not be established, the State Governments also had set up number of factories during the last two decades. For purpose of managing these factories, States like U. P., Bihar, Tamil Nadu, etc., had established Sugar Corporations (State Government Undertakings).

20.6 Table 21 gives the State-wise number of sugar factories in different sectors.

20.7 It may be noted that the number of factories in the cooperative sector is progressively increasing. The increase is considerably significant in Maharashtra. Thus, in 1973-74, out of 84 cooperative factories, 35 have been in Maharashtra, in 1982-83, out of 320 total number of sugar factories, 156 were in the cooperative sector, out of these 67 have been from Maharashtra.

20.8 The Statewise duration of the crushing season in India from 1976-77 to 1985-86 is given in Table 22.

20.9 The average duration of the crushing season in India is about 175 days. The duration of the season however depends upon the availability of cane to the sugar industry. In some areas where the sugarcane production has been excess, more cane remained available to sugar factories and they have been crushing for longer periods. Thus in the year 1981-82, some of the Maharashtra factories had to crush upto 200 days. Similar is the situation in States like U.P. and Tamil Nadu, where the duration of the season ranges from 180 to 200 days.

20.10 The State-wise cane crushed by sugar factories in India is given in Table 23.

20.11 While average recovery on all India basis ranges from 9.5 to 9.98, the maximum recovery was recorded in Maharashtra. In the year 1981-82 season, the average recovery in Maharashtra was 10.70. Next to Maharashtra, Karnataka recorded higher recovery. In 1981-82 season, the recovery in Karnataka was 10.09. The lowest

recovery is in South Bihar 7.65%. Tamil Nadu also recorded low recovery of the order of 8.80 (in 1981-82 season). The reasons for the low recovery in some areas like Bihar, Andhra Pradesh, Tamil Nadu and Orissa are different from State to State. In Tamil Nadu, though the standard of cultivation has been high, many of the cane growers employed large number of irrigation resulting in more versatile growth of cane. In Bihar, particularly in South Bihar, most of the area remains under water logged condition particularly in the growth period due to severe floods. In Andhra Pradesh and other coastal areas in the country, the cane and its sugar contents are affected by cyclone and other severe agro-climatic conditions.

21. Organisations for the Development of Sugar Industry

21.1 The principal organisation which attends to the development of sugar industry in India is the Government of India, in the Department of Food and Civil Supplies, Krishi Bhavan, New Delhi. It formulates the overall policies relating to the progress of and looks after the sugar industry under the provision of various Acts such as - The Industries (Development and Regulation) Act, 1951; Essential Commodities Act, 1955; Central Sugarcane Act, 1934; Sugar Export Promotion Act etc. etc. The Directorate of Sugar in the Department of Food attends details of the function of the Sugar Industry with the help of Department of Industries, Directorates, etc. of different States.

21.2 The Development Council for Sugar Industry set up under the powers conferred by Industries (Development and Regulation) Act, 1951, formulates the principles/pattern of development of sugar industry in India. The functions of the Council are as follows

- (a) Recommending targets for production, coordinating production programmes and reviewing progress from time to time.
- (b) Suggesting norms of efficiency with a view to eliminating waste, obtaining maximum production, improving quality and reducing costs.
- (c) Recommending measures for securing the fuller utilisation of the installed capacity and for improving the working of the industry particularly of the less efficient units.
- (d) Promoting arrangements for better marketing and helping in the devising of a system of distribution and sale of the produce of the industry which would be satisfactory to the consumer.
- (e) Promoting standardisation of products.
- (f) Promoting or undertaking inquiry as to material and equipment and as to methods of production management and labour utilisation including

Table - 23

STATEWISE CANE CRUSHED BY SUGAR FACTORIES IN INDIA

(In '000 tonnes)																				
State	1976-77		1977-78		1978-79		1979-80		1980-81		1981-82		1982-83		1983-84		1984-85		1985-86*	
	Coop. Tl.	Coop. Tl.	Coop. Tl.	Coop. Tl.	Coop. Tl.	Coop. Tl.	Coop. Tl.	Coop. Tl.	Coop. Tl.	Coop. Tl.	Coop. Tl.	Coop. Tl.	Coop. Tl.	Coop. Tl.	Coop. Tl.	Coop. Tl.	Coop. Tl.	Coop. Tl.	Coop. Tl.	
1. A.P.	911	3063	1776	4626	1115	3433	595	2328	730	2875	2099	6320	1773	5662	1113	3054	1410	3774	1834	4225
2. Assam	83	84	74	81	104	128	69	89	40	61	91	145	74	121	60	60	30	37	27	27
South Bihar	—	78	—	103	—	81	—	28	—	56	—	163	—	127	—	45	—	13	—	11
North Bihar	—	2079	—	3015	—	2834	—	1778	—	2059	—	3655	—	4326	—	2414	—	1508	—	2622
3. Bihar (Total)	—	2157	—	3118	—	2915	—	1806	—	2115	—	3818	—	4453	—	2459	—	1521	—	2633
4. Goa	73	73	104	104	88	88	67	67	57	57	120	120	106	106	79	79	80	80	67	67
5. Gujarat	2280	2280	3163	3163	2932	2932	2095	2095	3337	3337	5461	5461	4945	4945	3724	3724	3717	3717	5086	5086
6. Haryana	489	1223	897	1802	708	1532	327	977	432	1217	888	2008	825	1925	787	1893	594	1467	784	1699
7. Karnataka	1878	4171	2468	5806	2195	4814	1257	2711	1820	3576	3183	6423	3164	6161	1793	3761	2253	4238	2517	4866
8. Kerala	161	200	222	279	220	300	139	199	156	199	164	207	162	220	92	131	69	90	65	82
9. M.P.	82	469	118	755	74	676	13	267	56	203	237	651	248	781	243	780	218	548	202	472
10. Mahara- shtra	12682	14381	16705	19245	16697	19236	11827	13150	16951	18883	25088	28292	24567	27625	16170	17904	19064	20854	19671	21316
11. Nagaland	—	70	—	90	—	106	—	83	—	47	—	73	—	81	—	43	—	25	—	26
12. Orissa	107	114	168	203	221	240	107	115	105	111	230	260	278	302	170	184	144	151	136	145
13. Punjab	678	940	789	1101	695	994	393	515	399	586	836	1534	791	1417	791	1396	785	1339	893	1502
14. Pondicherry	—	310	—	266	—	315	—	208	—	265	—	289	—	285	49	210	119	309	251	560
15. Rajasthan**	120	344	223	513	117	353	16	116	42	128	78	250	71	260	51	243	26	197	52	145
16. Tamil Nadu	1486	3792	2335	5466	2428	5768	1481	4078	1696	4954	3364	8588	3117	7202	1851	4564	2670	6288	3591	8491
East U.P.	260	3972	309	5239	225	4168	77	2801	82	2877	306	5735	245	5747	242	4232	252	2849	468	4889
West U.P.	344	5072	718	6797	531	4739	417	3415	639	4608	1225	7404	1134	6953	1251	6837	1231	6057	881	4758
Central U.P.	646	5962	1326	8510	1239	6860	841	3989	1076	5436	2308	9650	2047	8343	1859	7446	1721	6541	2348	7566
17. U.P.(Total)	1250	15006	2353	20546	1995	15767	1335	10205	1800	12921	3839	22789	3426	21043	3352	18515	3204	15447	3697	17213
18. West Bengal	—	142	—	165	—	120	—	41	—	49	—	114	—	108	—	24	—	8	—	7

ALL INDIA 22280 48819 31395 67329 29589 59717 19721 39050 27628 51584 45678 87342 43547 82697 30325 59024 34383 60090 38873 68565

**Including sugar beet crushed.

*Provisional

Table - 24

STATE-WISE SUGAR PRODUCTION BY SUGAR FACTORIES IN INDIA

State	(In '000 Tonnes)											
	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86*		
	Coop. Tl.	Coop. Tl.	Coop. Tl.	Coop. Tl.	Coop. Tl.	Coop. Tl.	Coop. Tl.	Coop. Tl.	Coop. Tl.	Coop. Tl.		
1. Andhra Pradesh	83 283	148 405	98 311	49 199	65 263	173 546	154 513	99 295	120 355	161 406		
2. Assam	7 7	6 7	8 11	5 7	3 5	8 12	4 8	5 5	2 3	2 2		
South Bihar	— 6	— 9	— 7	— 2	— 5	— 13	— 10	— 4	— 1	— 1		
North Bihar	— 193	— 277	— 251	— 163	— 189	— 331	— 360	— 221	— 143	— 249		
3. Bihar (Total)	— 199	— 286	— 258	— 165	— 194	— 344	— 370	— 225	— 144	— 250		
4. Goa	6 6	9 9	8 8	6 6	5 5	12 12	10 10	7 7	7 7	6 6		
5. Gujarat	229 229	310 310	297 297	222 222	332 332	531 531	473 473	392 392	403 403	557 557		
6. Haryana	45 112	74 148	63 133	29 91	38 103	78 172	84 185	75 172	55 137	69 161		
7. Karnataka	196 421	251 574	229 487	128 271	193 371	325 648	324 627	182 383	230 441	262 509		
8. Kerala	12 14	18 23	17 23	11 16	14 17	14 17	15 19	8 10	6 8	6 7		
9. Madhya Pradesh	7 43	11 69	7 62	1 24	5 17	20 58	25 75	23 74	20 51	18 42		
10. Maharashtra	1387 1559	1821 2095	1831 2105	1260 1394	1877 2085	2687 3026	2696 3025	1803 1993	2121 2311	2210 2389		
11. Nagaland	— 6	— 7	— 9	— 7	— 4	— 7	— 6	— 3	— 2	— 2		
12. Orissa	9 10	14 17	18 20	9 10	9 10	18 21	22 24	16 17	13 14	13 14		
13. Punjab	64 86	73 99	67 94	41 52	35 51	83 149	85 150	85 146	85 142	87 146		
14. Pondicherry	— 26	— 23	— 26	— 16	— 21	— 25	— 26	4 19	11 28	23 51		
15. Rajasthan**	12 32	20 45	12 34	1 11	4 12	8 23	7 26	5 23	3 19	5 13		
16. Tamil Nadu	133 322	209 468	213 491	139 367	153 430	305 755	284 651	176 424	259 600	349 811		
East U.P.	24 380	29 475	21 377	7 260	7 268	27 516	23 513	22 392	22 267	41 456		
West U.P.	33 494	64 624	49 457	41 347	58 434	114 704	113 720	119 651	118 579	81 457		
Central U.P.	66 597	118 762	114 628	83 390	105 522	201 861	192 802	167 684	161 632	323 736		
17. U.P. (Total)	123 1471	211 1861	184 1462	131 997	170 1224	342 2081	328 2035	308 1727	302 1478	345 1619		
18. West Bengal	— 13	— 14	— 10	— 3	— 4	— 10	— 9	— 2	— 1	— 1		
ALL INDIA	2313 4840	3175 6461	3052 5841	2032 3858	2903 5148	4604 8437	4511 8229	3188 5917	3637 6144	4113 7016		

Coop. % of

Production

47.8 49.1 52.3 52.7 56.4 54.6 54.8 53.9 59.2 58.6

**Includes sugar recovered from sugar beet.

*Provisional

Table - 25

STATEWISE AVERAGE RECOVERY OF SUGAR PER CENT CANE IN INDIA

State	1976-77 Coop. Tl.	1977-78 Coop. Tl.	1978-79 Coop. Tl.	1979-80 Coop. Tl.	1980-81 Coop. Tl.	1981-82 Coop. Tl.	1982-83 Coop. Tl.	1983-84 Coop. Tl.	1984-85 Coop. Tl.	1985-86 Coop. Tl.									
1. Andhra Pradesh	9.08	8.33	8.75	8.77	9.05	8.15	8.57	8.85	9.14	8.26	8.64	8.69	9.07	8.89	9.66	8.53	9.41	8.79	9.60
2. Assam	8.94	8.89	8.68	8.41	8.17	8.25	8.01	7.97	8.09	8.60	8.61	5.80	6.66	8.16	8.16	8.26	7.87	7.82	7.82
South Bihar	—	8.30	—	8.26	—	8.51	—	7.60	—	8.13	—	7.65	—	8.04	—	7.80	—	7.21	—
North Bihar	—	9.27	—	9.19	—	8.87	—	9.14	—	9.19	—	9.06	—	8.32	—	9.16	—	9.46	—
3. Bihar (Average)	—	9.24	—	9.16	—	8.86	—	9.11	—	9.17	—	9.00	—	8.32	—	9.13	—	9.44	—
4. Goa	8.54	8.54	8.74	8.74	9.01	9.01	8.22	8.22	8.51	9.65	9.65	9.31	9.31	9.29	9.29	9.05	9.05	8.89	8.89
5. Gujarat	10.05	10.05	9.80	9.80	10.14	10.14	10.58	10.58	9.95	9.72	9.72	9.57	9.57	10.52	10.52	10.84	10.84	10.96	10.96
6. Haryana	9.13	9.17	8.25	8.22	8.83	8.69	8.97	9.35	8.85	8.43	8.77	8.59	10.20	9.47	9.52	9.07	9.25	9.35	8.73
7. Karnataka	10.43	10.08	10.18	9.83	10.43	10.12	10.18	9.99	10.60	10.37	10.23	10.09	10.23	10.18	10.14	10.19	10.22	10.40	10.46
8. Kerala	7.28	7.19	8.26	8.11	7.68	7.55	8.26	7.94	8.67	8.47	8.48	8.08	8.89	8.47	8.45	7.93	9.22	8.73	9.47
9. Madhya Pradesh	9.00	9.20	9.05	9.08	9.35	9.11	7.95	8.89	7.94	8.43	8.63	8.84	10.08	9.54	9.56	9.43	9.27	9.32	9.11
10. Maharashtra	10.94	10.84	10.90	10.89	10.96	10.95	10.65	10.60	11.07	11.04	10.71	10.70	10.97	10.95	11.15	11.13	11.13	11.08	11.23
11. Nagaland	—	8.55	—	8.35	—	8.09	—	8.96	—	8.24	—	9.02	—	7.42	—	7.93	—	8.26	—
12. Orissa	8.55	8.54	8.18	8.34	8.28	8.34	8.43	8.46	8.96	8.70	8.03	8.19	7.88	7.98	9.31	9.32	9.09	9.10	9.44
13. Punjab	9.36	9.16	9.32	9.02	9.62	9.43	10.32	10.14	8.90	8.67	9.90	9.71	10.76	10.62	10.72	10.47	10.76	10.63	9.76
14. Pondicherry	—	8.42	—	8.47	—	8.31	—	7.79	—	8.06	—	8.78	—	8.96	8.66	8.78	8.92	9.23	9.17
15. Rajasthan**	10.12	9.36	8.84	8.78	10.29	9.55	8.46	9.45	9.61	9.49	10.00	9.13	10.31	9.83	10.56	9.44	10.01	9.85	9.20
16. Tamil Nadu	8.95	8.48	8.94	8.57	8.78	8.52	9.40	9.00	9.04	8.68	9.07	8.80	9.11	9.04	9.53	9.30	9.71	9.54	9.73
East U.P.	9.11	9.55	9.27	9.07	9.13	9.05	8.64	9.29	8.72	9.30	9.01	9.00	9.24	8.92	9.24	9.25	8.90	9.37	8.80
West U.P.	9.65	9.74	8.88	9.18	9.27	9.66	9.75	10.15	9.11	9.41	9.29	9.51	9.98	10.36	9.49	9.52	9.59	9.55	9.20
Central U.P.	10.19	10.02	8.92	8.96	9.21	9.16	9.92	9.79	9.68	9.62	8.69	8.92	9.41	9.62	8.95	9.19	9.37	9.69	9.49
17. U.P. (Average)	9.81	9.80	8.95	9.06	9.22	9.28	9.79	9.77	9.43	9.47	8.91	9.13	9.58	9.67	9.17	9.33	9.42	9.57	9.33
18. West Bengal	—	9.24	—	8.70	—	8.15	—	7.52	—	7.31	—	9.21	—	8.41	—	7.42	—	5.76	—
ALL INDIA	10.38	9.91	10.11	9.59	10.31	9.78	10.30	9.88	10.51	9.98	10.08	9.66	10.36	9.95	10.51	10.02	10.58	10.22	10.58

**Includes recovery of sugar per cent sugarbeet

*Provisional

the discovery and development of new materials equipment and methods and of improvements in those already in use, the assessment of the advantages of different alternatives and the conduct of experimental establishment and of tests on a commercial scale.

- (g) Promoting the training of persons engaged or proposing to be engaged in the sugar industry and their education in technical or artistic subjects relevant thereto.
- (h) Promoting the retraining in alternative occupations of personnel engaged in or retrenched from the industry.
- (i) Promoting or undertaking scientific and industrial research, research into matters affecting industrial psychology and research into matters relating to production and to the consumption or use of goods and services supplied by the industry.
- (j) Promoting improvements and standardisation of accounting and costing methods and practice.
- (k) Promoting the adoption of measures for increasing the productivity of labour, including conditions and the provision and improvement of amenities and incentives for workers.
- (l) Undertaking arrangements for making available to the industry information obtained and for advising on matters with which the Development Council is concerned in the exercise of any of its functions.
- (m) Assisting in the distribution of controlled materials and promoting arrangements for obtaining materials for the industry.
- (n) Promoting or undertaking the collection and formulation of statistics.
- (p) Investigating possibilities of decentralising stage and processes of production with a view to encouraging the growth of allied small scale and cottage industries.
- (q) Advising on any matters relating to the industry (other than remuneration and condition of employment) as to which the Central Government may request the Development Council to advise and undertaking inquiries for the purpose of enabling the Development Council to advise.
- (r) Such other functions as the Central Government may from time to time assign to the Development Council.

22. Labour in Sugar Industry

22.1 Sugar Industry is the second largest industry which provides employment to a large number of technical and non-technical personnel. They are connected directly and indirectly with the processing of sugarcane into sugar. Sugar industry is one of the

largest pay masters, the aggregate salaries, wages and other benefits accrued to the labour employed in the sugar industry amount to about Rs.1000 crores per year.

22.2 The number of persons employed per factory in the year 1965-66 (as considered by Second Wage Board) is given in Table 26.

Table 26
Number of Persons Employed Per Factory in 1965-66

State	1965-66
Andhra Pradesh	946
Assam	924
Bihar	1044
Gujarat	620
Kerala	798
Madhya Pradesh	967
Maharashtra	871
Karnataka	921
Orissa	473
Pondicherry	546
Punjab	903
Rajasthan	960
Tamil Nadu	906
Uttar Pradesh	1203
West Bengal	997

Table 27
Percentage of Seasonal and Non-Seasonal Employees in Sugar Factories

State	Seasonal	Non-Seasonal
Andhra Pradesh	55.3	44.7
Assam	78.2	21.8
Bihar	75.4	24.6
Gujarat	65.4	34.6
Kerala	55.4	44.6
Madhya Pradesh	79.4	20.6
Maharashtra	49.4	50.6
Karnataka	59.0	41.0
Orissa	47.7	52.3
Pondicherry	61.2	38.8
Punjab	65.6	34.4
Rajasthan	76.6	23.4
Tamil Nadu	45.3	54.7
Uttar Pradesh	71.4	28.6
West Bengal	47.7	25.3
ALL INDIA	64.9	35.1

Table - 28
Percentage Composition of Employees Belonging to Different Categories

State	Un-skilled	Semi skilled	Skilled	Highly skilled	Clerks	Super-visory	Techni-cal & Profe-ssional	Admini-strative & Exe-cutive	Others
Andhra Pradesh	44.3	18.9	12.1	2.3	13.4	1.9	0.9	0.4	5.4
Assam	61.4	14.9	4.8	2.8	15.0	0.9	-	0.2	-
Bihar	59.5	16.6	7.0	1.0	11.3	0.9	0.4	0.4	2.5
Gujarat	34.4	14.9	8.6	3.2	22.8	1.8	0.4	0.2	13.7
Kerala	36.8	19.9	12.1	2.6	11.3	1.8	1.0	3.0	11.8
Madhya Pradesh	63.0	14.8	8.5	1.3	9.5	0.8	0.4	0.2	1.5
Maharashtra	46.2	21.0	12.8	1.7	12.3	1.6	1.1	0.5	2.8
Orissa	36.7	26.8	16.4	1.9	14.1	-	2.7	1.3	0.1
Pondicherry	45.5	17.3	12.3	3.1	17.2	4.6	-	-	-
Punjab	48.7	21.7	8.7	1.9	14.6	1.4	0.6	0.4	2.0
Rajasthan	56.4	17.7	6.7	1.4	11.8	1.4	0.1	0.2	5.3
Uttar Pradesh	57.9	19.1	7.5	1.6	9.5	0.7	0.5	0.3	2.9
Tamil Nadu	46.7	16.9	12.5	2.7	14.3	1.9	1.2	0.8	2.7
West Bengal	51.6	21.6	7.6	1.6	16.0	1.1	0.4	0.1	0.6
All India	53.1	18.0	9.3	1.7	11.6	1.2	0.6	0.5	3.1

Daulat Shetkari Sahakari Sakhar Karkhana Ltd.

HALKARNI

Tal. Chandgad, Dist. Kolhapur (Maharashtra State)

Tel: DAULSAKHAR, Belgaum

Phone: 22403 (Belgaum)

SPECIAL FEATURES

- * Karkhana is expanding its present crushing capacity from 1250 TCD to 2000 TCD. Erection is in full swing and ensuing season will be started with expanded capacity.
- * Erection of 'Biostil Fermentation Distillery' is in full swing and will be commissioned during November 1986.
- * Karkhana has established 'Daulat Polytechnic' from last three years for the educational development of area of operation.
- * Successful implementation of 20 Point Programme for the rural development in the area of operation.
- * Developed cane breeding centre to supply healthy cane seeds of recent varieties to cane growers.
- * Karkhana has sponsored lift irrigation schemes on Co-operative basis in area of operation to up-lift the small cane growers.

G. M. PATIL
I/c Managing Director

NARSINGRAO G. PATIL
Chairman

22.3 Further the sugar industry is a seasonal industry, number of persons are employed on the seasonal basis and others remain on non-seasonal or permanent basis. Table 27 gives an approximate indication of the percentage composition of seasonal and non-seasonal employees in the sugar industry.

22.4 Sugar industry is a complicated industry and consists of not only engineering and technology processes, but also requires number of administrative personnel. It employs unskilled, semi-skilled, skilled and highly skilled technicians and supervisory staff.

22.5 Table 28 gives the percentage composition of employees belonging to different categories

21.6 It may be pointed that on an average about 1000 persons are employed in a sugar factory. With modernisation and continuous operations, employed for not only improving the technical efficiency of operation of sugar factories, but also for improving the economics of the industry, the National Federation of Cooperative Sugar Factories had appointed a Committee to work out the minimum persons required for running a 1250 TCD plant.

22.7 The wages in the sugar industry are paid in accordance with the recommendations made by the Central Wage Board for Sugar Industry appointed by Government of India from time to time. The Second Central Wage Board for Sugar Industry submitted its Report in 1970, the recommendations of the same are now operative and governs the wage structure of the labour employed in the sugar industry. The total minimum payable to unskilled workers is roughly as follows :

Basic Wages	 Rs. 292.00
Graduated D. A.	 Rs. 52.00
Variable D. A.	 Rs. 132.60

Total	 Rs. 476.60

22.8 The Wage Board made recommendations regarding the Wage Structure for other categories including skilled, semi-skilled and the trained personnel employed in sugar industry. Sugar factories pay however, wages according to the marked demand to employees of other categories or supervisory or officer level.

22.9 According to the recommendations of Second Wage Board, employees in supervisory, clerical and highly skilled grades get retaining allowance at 5% of their monthly basic pay and D.A. and those in the semi-skilled grades at 25% of their monthly basic pay and D.A. Demands regarding the retaining allowance to unskilled workmen are under consideration. With a view to ensure smooth implementation of the Wage

Board recommendations, the Union Government requested both employers and workers to hold talks between them either directly or under the auspicious of the State Governments for evolving mutual acceptable principles of payment of wages or any other matter taking into account varying local conditions. Such Tripartite Committee set up by different State Governments particularly U. P. Government meet and discuss the matter relating to welfare of the labour in the industry.

23. Fiscal Income

23.1 Sugar Industry occupies the prominent place in the economic map of India and contributes substantially to the nation's fiscal income. Central and State Governments levied very heavy taxation on cane and the sugar produced in the country. Cane cess and purchase tax levied on cane sold to sugar factories varied from State to State.

23.2 The same has been discussed in some detail earlier. The amount of State-wise cane cess/purchase tax collected in the years 1960-61 to 1979-80 has been given in Table 15. It may be noted that Maharashtra collected in 1979-80, Rs.22.55 crores as cane cess/purchase tax; in U. P. the collection was about Rs.17.87 crores.

23.3 From the year 1934, the Central Government has been levying excise duty on sugar. The total revenue from sugar by way of excise duty collected by the Central Government for the years 1950-51 to 1977-78 is given in Table 29. It may be noted that the contribution from the sugar industry to the national exchequer is of the order of Rs.200 to 227 crores per year.

Table 29
Excise Duty Collected by Central Government

Year April/March	Amount in Laksh Rs.	Year April/March	Amount in Lakhs Rs.
1950-51	656	1965-66	7500
1951-52	847	1966-67	11012
1952-53	1017	1967-68	7396
1953-54	1341	1968-69	6655
1954-55	807	1969-70	10215
1955-56	1844	1970-71	13798
1956-57	2075	1971-72	16320
1957-58	4251	1972-73	17540
1958-59	6026	1973-74	19547
1959-60	5975	1974-75	19050
1960-61	5482	1975-76	22495
1961-62	5482	1976-77	22745
1963-64	6617	1977-78	20174
1964-65	6518		

23.4 It may be pointed out that excise duty being collected by Central Government varies from year to year and depends upon the production, which again is controlled by the sugarcane production and availability of the same to sugar factories. The weather conditions play a significant role on these factors. The excise duty collected by Central Government from sugar factories is shared with State Governments in a designated ratio and proportionate to the quantity of sugar produced in respective States.

24. Conclusion

24.1 Sugar Industry is the second largest industry in the country, next to textiles. The capital outlay in the sugar industry is more than Rs.2,500 crores, with an annual turnover ranging from Rs.3000-3500 crores. Being an agrobased industry and depending upon raw material which undergoes rapid deterioration and which necessarily is to be processed fast, almost immediately after harvesting, most of the sugar factories are situated amidst sugar canefields, in rural areas. Thus the sugar industry helps considerably

in development of rural areas. Every year approximately Rs.2000 crores are paid as cane price by the sugar industry. This amount flows into the economy of rural population, which helps considerably in improvement of socio-economic set-up of vast masses of population residing in villages in India. The sugar industry provides direct and indirect occupation and employment for millions of people in the country. The industry also helps immense number of engineering industries located in rural and urban areas.

24.2 In view of the significant and commendable role that sugar industry plays, apart from production of a very valuable food material, in the improvement of the economy of vast multitudes of families in villages, Government of India accords considerable guidance, help and assistance to sugar industry. It is praiseworthy to point out that because of the immense support from Government of India, the infant sugar industry of 1930's producing hardly 13 lakh tonnes of sugar has grown into a giant industry with a capacity to produce about 100 lakh tonnes of sugar, with the assured potential of being the foremost in the world.

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A PROFILE OF SUGARCANE SOILS IN INDIA. CHARACTERISTICS AND BROADBASE BEHAVIOUR

DR. G.K. ZENDE

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Introduction

Soil is the real reservoir of our wealth. It provides medium for the sugarcane crop to grow. It also provides bulk of nutrients. Soil is the living entity in the sense, millions of organisms live in the soil and bring about bio-chemical and biological changes almost continuously. Soil is not mere powdered mineral rocks. The organisms, moisture, air, organic matter should be present alongwith powdered mineral rocks, in proper proportions and level, to make a soil productive. Soil is important to the farmer in many ways. For the soil to function efficiently, the farmer has to take good care of physical, bio-chemical and biological aspects of the soil. Their characteristics, particularly in the top one and half foot layer of the soil, are important, as most of the functioning roots of the sugarcane crop are confined to this top layer. Unless physical conditions of the soil are ideal, the nutrients naturally present or artificially applied, are not adequately absorbed by the crop roots and the crop suffers from nutritional deficiencies to a degree of not exhibiting diagnostic symptoms, but they yield less than their potential level.

Soil may be defined as a layer of more or less loose material covering the surface of the earth in which plants are able to grow. Soils are formed as a result of the processes of decay that the rocks have undergone through centuries due to climatic and biolo-

gical agencies to which they are exposed. The resultant effect of the activity of various soil components ultimately determines the fertility of soils. Soil management practices vary a great deal according to soil types and hence study of soil types is a pre-requisite for scientific farming and for increasing the crop production in a given situation. The solution of our agricultural production problem lies in the exploitation of the potentialities of the native soil in the most judicious manner. To ensure optimum agricultural production, it is necessary to know the basic facts about our soils on profile basis formed in different agroclimatic conditions from varying parent material under diverse topographic situations. (Parthasarathy et al. 1979, Parthasarathy and Perumal, 1978, Anonymous 1957, 1972).

The role of sugarcane soil studies and chemistry in the planned development of sugarcane in India has been dealt in depth by Mukerjee (1958). In the present paper, an attempt has been made to study on a broad basis the system of soil classification adopted, characteristics of sugarcane soils, problems posed in their management and their behaviour in changing environment.

Soil Survey and Soil Classification

Sugarcane is a crop which can be grown profitably under favourable climatic conditions on any type of

soil ranging from very shallow to very deep ones. It is successfully grown in the acid soils of Kerala where the annual rainfall exceeds over 2500 mm as well as on the frost affected saline areas in the Punjab (Raychaudhari et al. 1960)

Soil survey of sugarcane lands has been in progress in this country for more than five decades and the increasing demand for soil classification both by the industry and the growers is an indication of the value that is attached to the scientific knowledge of soils in sugarcane development.

The differentiating characteristics adopted for the survey of sugarcane soils in India are mainly those which within a geographical unit are found to be the most important factors in growth and development of the crop. In Penninsular India, where soil formation has taken place on rocks of prearchean period, the drainage characteristics have been considered as most important for classifying and characterizing sugarcane soils. In North India, on the other hand, the composition and character of the parent alluvium as well as soil topography have been assigned a position of top priority. At the lower category level, the hydro-morphic and orographical characteristics have been found important from the point of view of cane growth (Anonymous, 1958). On a broad basis, the sugarcane soils belong to the three categories namely - (1) alluvial soils, (2) black soils, and (3) red soils.

Major bulk of sugarcane cultivation is concentrated on alluvial soils. These soils are located in States of Punjab, Uttar Pradesh, Bihar and West Bengal. Soils vary in texture from sandy to clayey and are either neutral or alkaline in reaction.

The sugarcane on black soils is mainly grown in the Deccan Canals, and Marathwada region of Maharashtra State, parts of Karnataka, Godavari district of Andhra Pradesh and parts of Madhya Pradesh (Sehore) and Gujarat (Bulsar, Surat, Kodinar etc.). These soils are alkaline in reaction and contain free calcium carbonate varying from one percent to twenty percent.

The red soils growing sugarcane are observed in West Bengal, parts of Karnataka, Tamilnadu, Southern parts of Bihar, Goa, Kerala etc. These soils are either neutral or acidic in reaction.

The method of classification of sugarcane soils in Bombay Deccan employed by Basu and Sirur (1938) - the pioneer workers in this regard - was the Genetic System followed in Russia, with certain modifications to suit the local conditions. The Genetic System of soil classification was first developed in Russia by the well-known pedologist Dokuchaieva in 1879 and was further put on a sound footing by Glinka. In this system, the soils are classified according to their origin and development,

both of which are influenced by variation in topography which ultimately affects the soil, climate, and development of a profile. The system takes into consideration the entire transverse section of the soil or the soil profile as the unit of study. The soil profile consists of a regular succession of layers or 'horizons' which are formed by the differential separation of the products of soil weathering, the differences in the environment setting up a variety of physical, chemical and biological processes within the soil resulting ultimately in certain distinct characteristics both in the morphological form and colloidal composition. The most practical aspect of the genetic classification is that all soils possessing similar profile characteristics will behave in an identical manner under similar agricultural treatments and can thus be grouped under one genetic type. Based on a detailed soil survey of 6,00,000 acres during the period 1932-44, the soils were grouped into twelve distinct types exhibiting fundamentally different soil characteristics. They were named chronologically from A to L for practical convenience. The classification was based mainly on drainage condition, topography and zone of accumulation of salt in the profile. (Fig. I and II).

Group I

Soils developed under restricted drainage - Salt accumulation.

- (a) closed type curve
- (b) Open type curve.

Group II

Soils developed under conditions of free drainage. - variation in free lime status.

Broad based features of 12 soil types are as under :

- Soil Type A - Intermediate, medium deep, black clay loam with reddish tinge.
- Soil Type B - Low lying, high lime, deep, brownish black, clay loam.
- Soil Type C - Low lying, deep, black, compact clays.
- Soil Type D - Intermediate, dark brown, calcareous clay loams.
- Soil Type E - Intermediate Grayish black clays.
- Soil Type F - High level, low lime, shallow, brown loams.
- Soil Type G - High level, moderate lime, dark brown, shallow clay loams.
- Soil Type H - High level, low lime, shallow, reddish brown loams.
- Soil Type I - Low lying, grayish black, deep compact clays.
- Soil Type J - Low lying, high lime, grayish black, deep clays with yellowish sub soil.
- Soil Type K - Intermediate, deep, black clay with

Soil Type L - whitish calcareous sub-strata.
Intermediate, medium deep, gray black,
clay loam with bouldering sub-strata.

According to Rege and Basu (1944), the soils of the Deccan canals belong to the broad group of Indian soils popularly known as Black Cotton Soils. Although these soils have a close similarity, they can not be put into the ischernosems or chestnut soils group of world group of classification, on account of various characteristics such as organic matter content, soil profile structure, zone of calcium carbonate and other soluble salts accumulation, eluviation of clay and sesquioxides. These authors preferred to class these soils in a separate group altogether and to term them as "immature tropical ischernosems". Based on the general soil survey of the major cane blocks under different canals, it was found that the six soil types i.e. 'A', 'B', 'C', 'D', 'F' and 'G' cover over 90 percent of the cane area in the Deccan Canal Tract.

(a) Alluvial Clays of Flood Plains, (b) Red Alluvial Soils of river border areas, (c) Lateritic soils of higher rainfall zone, (d) Residual deep black clay - low lime 'B', (e) High level low lime, reddish brown shallow loam similar to 'H' type, (f) Intermediate, medium deep, black clay loams similar to 'A' Type. In a similar way, 45,000 acres of cane area from Panchaganga Valley was surveyed and soil type maps were prepared.

In the recent past, reconnaissance soil survey with the object of recognising soil types was completed in regard to Bardoli - Gandevis tract in Surat/Bulsar districts, Kodinar tract, Osmanabad district, Buldhana district and Dhulia district. Based on the results of the experiments conducted at the main Sugarcane Research Station, Padegaon and various sub-stations and trials on cultivator's fields, the cane growers are given advice in regard to cultivation and manuring practices. The soil advisory service started functioning systematically from 1956. The various sugar factories and cane growers have been profited immensely from the work of the soil survey and soil classification and its utilization in improving and maintaining soil fertility.

The sugarcane soils as found in different parts of Maharashtra have been studied by different workers (Joshi and Mahajan, 1964, Joshi et al 1969, Joshi and Dakshindas, 1962, Joshi and Bindu, 1964, Joshi et al 1967, Joshi and Mahajan 1964, Joshi et al, 1961, Joshi 1967, compiled all this information at one place in the form of Research Bulletin.

In classifying the soils of the sugar belt of Bihar, the differentiating criteria at the higher level has been the character and composition of the parent alluvium and variation of the climate, the former being dominant in determining the soil characteristics. Five broad soil divisions have been recognised in the tract viz. the non-calcareous division in North Bihar differentiated mainly on the basis of the free calcium carbonate, some alluvium and heavy clay soils of the Ganges, distinguished texturally according to the source and mode of deposition of the alluvium and brown soils developed on gangetic alluvium of south Bihar as a result of silicate weathering under restricted leaching conditions. (Prasad, Bhattacharya and Sinha 1950 and Bhattacharya, Srivastava and Khanna, 1954).

In Punjab, the sugarcane soils of the Jagadhri Sugar Mill area were classified into four types as - (i) Freshly deposited alluvium, (ii) Leached Yellow earth, (iii) Acid Soils, (iv) Alkaline intra-zonal soils. The soils of Hamira factory were classified into four main categories based on leaching intensity and impregnation with lime or ferrogeneous nodules.

The main groups of soils in Andhra Pradesh are black soils, red soils and alluvial soils. There are laterites in Nellore and Godavari districts and parts of Telengana. Black soils are the most extensive and these are fertile.

The soils are generally poor in organic matter. The soils are highly hygroscopic, expand and contract very much with pH 8.0 to 9.0. The red soils are loamy and rarely clayey. They drain easily. The soils are poor in org. matter with a pH of 6.5 to 8.0. The soils of Nizam Sugar Factory zone were classified into two main groups - (i) Black or Regur, and (ii) Red or Chalka.

The soils of Karnataka State vary considerably due to combination of geological parent material, effects of climate and topography. Six broad soil groups are identified - namely (i) Black Soils - medium black and deep black, (ii) Red Soils - Red loam and Red, (iii) Mixed Red and Black Soils, (iv) Laterite Soils, (v) Coastal Alluvials, and (vi) Dark brown clayey soils (Perur and Mithyantha, 1972).

The soils of Tamil Nadu are classified into nine major groups - namely - (i) Black Soil, (2) Sandy coastal alluvium, (3) River alluvium, (4) Laterite, (5) Ferruginous red loam, (6) Ferruginous red sterile soil, (7) Ferruginous red sandy soil, (8) Ferruginous shallow red soil, and (9) Ferruginous deep red loams. Ramaiah (1944) summarised the soils of this state. (Ratnam et al 1972).

Soil - Climate and Sugarcane Growth

Climate plays a major role in the formation of a soil from rock minerals. Climatic conditions not only affect the depth of a soil profile but the characteristics of each horizon is a reflection of the effect of prevalent climate over a long period. Parent materials of different chemical composition can give rise to a similar type of soil under the influence of common climatic parameters. On the other hand, the same parent material under varying climatic conditions results in the formation of two distinct soil types. The soil and climate together affect the crop growth considerably due to variation in fertility status and management practices adopted.

Sugarcane is a crop that grows round the year as a twelve month crop and in some places (as in Maharashtra) it grows for 18-22 months. From planting to harvest in India, it grows through violent fluctuations in climatic factors, like high temperature of 105° - 112° F in summer, 30° - 35°F in winter, dry spell in summer and heavy downpour of rain even 150 to 300 mm in 24 hours in monsoon months. Being a giant crop, it grows fairly well through such large fluctuations in climate. The physical features of a cane stalk bear marks of such climatic changes and an experienced eye can interpret the climate of the past months by a close study of the morphology of the successive internodes of the cane stalk. Sugarcane is essentially a tropical crop loving warmth and moisture for its growth, and mild cold and mild drought for maturity. (Parthasarathy, 1972).

Characteristics of Sugarcane Soils from different States

Due to variation in Agro-climatic conditions, the soils from different parts of Maharashtra vary considerably in their physico-chemical characteristics. The nature of soil types prevalent and their characteristic features in different regions or districts of Maharashtra State are illustrated in Tables 1 to 5.

Data from Table 1 reveals that soil types B and D are highly calcareous. Soil types A, B, C and D are more or less alkaline and soil types A and G are high in exchangeable calcium.

In Krishna canal and Kolhapur regions, the variation in clay content, Soil pH, exchangeable Calcium and Soil texture in different soil types is fairly large. Alluvial clays and red alluvial soils show high status for total Nitrogen. None of the soils show salinity and as such all soil types show fair level of soil fertility indicating possibility of getting high cane yields per acre in all soil types of Krishna Canal and Kolhapur Region.

For each soil type, a sugarcane research station has been established to study the relative performance of each soil type in the respective regions. The characteristic features of nine such centres are reported in Table 2. It is observed that soils at Dhoki, Hol, Akluj and Krishna Canal areas are highly clayey. Soils at Padegaon and Akluj are high in contents of free lime. Most of the soils are slightly alkaline to alkaline in reaction. Soils vary in their contents of both exchangeable calcium and magnesium. Lakhmapur soil appears to be high in phosphate as compared to all other centres included in Table. In view of variation in most of the characters, they pose differential problems in their management.

The major soil types encountered in six major districts of Maharashtra State growing sugarcane are indicated in Table 3. The proportion of area under each type in different district varies and as such the total yield potential of such district is also expected to be different posing problems in their efficient management.

Saline alkali soils pose a serious problem in many districts both in their management as well as in getting higher yields. Baramati area from Pune district is a typical example of saline alkali soils. The characteristic features of these saline alkali soil profiles are depicted in Table 4. Deep black saline and Alkali profile show a variation in their salt load distribution. It decreases with depth in deep black saline soil, while it increases with depth in an alkali profile. Salinity is mostly due to Sodium Sulphate and partly due to Sodium Chloride in a deep black soil. Monovalent bases are fairly high in Sodiumised Black Soil - A type. Alkali soil shows a high proportion of soil pH due to presence of high

proportion of Sodium Carbonate.

Nearly 15 lakh soil samples have been analysed from different districts of Maharashtra State in nine soil testing laboratories during the last two and half decades. The parker values worked out for three soil parameters are reported in Table 5. The variation in the values for different districts is quite large. In general, soils from different districts are low in organic carbon and available Phosphate. This fact has to be kept in mind while cultivating these soils for sugarcane and making appropriate changes in their management.

Soil data for Gujarath State is illustrated in Tables 6 to 9.

Sugarcane is grown on a large scale in Bardoli tract, Gandevi area and Kodinar tract. The characteristic features of soil from typical villages from Gandevi area are illustrated in Table 6. It is seen that most of the soils are clayey in texture, neutral to alkaline in reaction, moderate in exchangeable calcium and medium to high in total Nitrogen. All soils, however, appear to be rather very low or low in available phosphate and potash. Appropriate care in soil and fertilizer management can result in getting higher cane yields with suitable varieties.

Soils from Kodinar Tract (Table 7) show a great variation in their texture, lime contents and status of exchangeable calcium. Most of the soils are slightly alkaline to alkaline in reaction. The soils, in general, show low status of available phosphate and potash. Care in soil and fertility management can help a lot in getting fairly good yields in this tract of Gujarath State.

Bardoli Tract is assuming dominance not only in high sugar production in the region but also getting higher yields on average basis. Characteristic features of soils from selected villages are illustrated in Table 8. These soils are low in free lime status but they show great variation in soil texture. Soils appear to be rather low in organic carbon, available phosphate and available potash. With good soil management and cane in fertilizer application, it can go a long way in getting higher cane yields per acre.

The soil features at Agricultural Research Station at Vyara are depicted in Table 9. The soil characters are more or less similar to those in Bardoli tract. It is felt that care in soil fertility management of sugarcane soils from Gujarath State can go a long way in improving crop yields in all regions of Gujarath State.

On volume basis, the soil data reported from other States like Andhra Pradesh, Uttar Pradesh, Tamil Nadu, Karnataka, Bihar, Orissa and Punjab are rather scanty but the data throw a good light on fertility status and major problems posed.

In Andhra Pradesh, the soils encountered at A. R. S., Anakapalli exhibit four types of soil texture (Table 10). However, all soil types show more or less neutral reaction. The soils also show low status of organic carbon and total Nitrogen percentage. Soils in general also indicate lower status of available K_2O in three out of 4 soil types.

At Nizam Sugar Factory area, the two main soil types prevalent are Red Soil and Black Soil (Table 11). These soils are low in free lime status, vary in their texture and show a poor fertility status. Soil fertility improvement programme assumes considerable importance in the Nizam Sugar Factory area. Red and Black soils have similar need for soil fertility improvement programme.

Soil characteristics from five different districts of U. P. are reported in Table 12 to 14.

The soils from Shahjahanpur, Sitapur and Barabanki districts of U. P. are practically neutral in reaction, vary low in the status of organic carbon and medium in P and K status as judged from the Parkar indices for these attributes (Table 12).

In Muzaffarnagar district of U. P., the three soil types encountered are loamy sands, sandy loams and clay loam. All are neutral in reaction. They differ considerably in their contents of exchangeable Calcium, total N, P and K, % organic carbon and even in C/N ratio. The values for organic carbon, total N exch. Ca and Total exchangeable bases are very low indicating low fertility status of soils. (Table 13)

In Kashipur Zone of Nainital district, representing foot hill soils, five types of soils are encountered. They are mostly silt loam, sandy loam or clay loam in texture. Exchangeable Ca and total exchangeable bases are also low. The soils in general are slightly acidic to neutral in reaction. Barring Kashipur Zone Type 1, soils from other categories are low in their water-holding capacity. The soils are well drained but are low in their chemical fertility. (Table 14)

The characteristic features of soils from South Arcot district, Kattur zone and five main soil types encountered in Tamil Nadu are deposited in Tables 15, 16 and 17.

It is observed that soils from all villages in Arcot district are very low in total Nitrogen, total soluble salts, available phosphate and available potash. In general, soils are slightly acidic to slightly alkaline in reaction and very low in free lime status. Soil fertility improvement programme will have to be given top priority in Arcot district. (Table 15)

The five soil types prevalent in Tamil Nadu vary considerably from each other in all respect. Texturally, they are light textured soils suggesting more adequate

care in their management (Table 16).

The soils from Kattur zone are heavy clays, low in all fertility constants. Most of the soils are either neutral to slightly alkaline in action with very low salt concentration. (Table 17)

Soil data from two districts of Karnataka State are illustrated in Tables 18 and 19. Soils from Bellary district show high degree of alkalinity, while they exhibit low status of available P and K in them. (Table 18). Variation in the fertility status of soils from different villages is fairly marked. Soils from three factory zones in Belgaum district also exhibit high alkalinity and low status of available P in them. (Table 19) Reclamation of alkali soils and improvement of soil fertility status assume importance in both the districts of Karnataka State.

Soils from North Bihar fall in three categories namely - non calcareous, calcarious and alkaline phase. All of them are low in their contents of organic carbon and total Nitrogen. Nitrogen releasing capacity is also very low for all the soils from North Bihar zone. This is well illustrated by the data reported in Table 20.

Soil fertility improvement programme has to be given highest priority for enhancing yields in North Bihar zone.

The soils from ten farms belonging to Harinagar Sugar Factory show similar variation in all parameters. High alkalinity in soils and low status of organic carbon appears to be the common feature of soils from the ten farms (Table 21). Supply of Potash in available form can be considered to be moderate. In respect of micro-nutrient status of these soils, they exhibit deficiency of Zinc in them. Deficiency of copper in sugarcane soils in two out of 10 farms is indicated. Manganese and iron are probably well supplied as seen from the data reported in Table 21.

In respect of Orissa and Punjab, soil data from only one sugarcane belt each is reported in Tables 22 and 23 respectively.

Soils from Rayagada cane belt in Orissa are highly acidic in reaction and low in organic carbon status. Sandy loam texture imposes a problem in water management due to low water holding capacity of soils. Low pore space and high density suggests compact nature of soil requiring care in crop management through development of better tilth of the soils. This is illustrated from the data reported in Table 22.

Soils from Jagadhri Sugar Mill area of Punjab fall in four categories exhibiting extremes in all parameters. Sandy nature of soil and low fertility status appear to be the basic problem in these soils as seen from the data reported in Table 23.

For comparing soils from one region of the country

to other regions of the world, the main approach adopted is to classify them systematically in orders and sub-orders based on taxonomic units. Raychaudhri and Govind Rajan (1971) attempted to suggest equivalent names in 7th approximation system of soil classification for all popular nomenclature of soils in respective situations. The equivalent names for all dominant soils are illustrated in Table 24. Adoption of this nomenclature can help to understand the inherent nature of soils from different regions, their problems in managements and common measures to be adopted for improving their productivity.

Micronutrient Status of Sugarcane Soils in India

The supply of micronutrients in adequate amounts and in proper proportion is one of the many factors that control the growth of plants. In the absence of these micronutrients, the plants are known to suffer from what are called physiological disorders which eventually lead to low crop yields and to loss of quality. Some of the important factors which directly or indirectly affect the availability of micronutrients are the reaction of soil, the contents of organic matter, the nature and amount of clay minerals and the microbial activity (Zende and Kibe, 1955).

Every year, increasing number of instances of trace element deficiencies are coming to light. Certain elements though present in very small quantities in the tissue are essential for the healthy development of the plants. These trace elements are boron, copper, manganese, molybdenum, iron and zinc. These trace elements are of interest not merely because of their biological significance but because the detailed study of their behaviour provides a clue to the several unsolved pedological problems. (Mukherjee, 1958). The trace element content of a soil is dependent almost entirely on the process of weathering both geochemical and pedo-chemical to which the soil forming materials have been subjected. The factors that govern separately and jointly the distribution of trace elements in the soil profile include the weathering process, leaching of soluble constituents, oxidation reduction effects and variable water tables, plant extraction and surface enrichment and the cumulative effect of the activity of the soil micro-organisms. (Zende, 1979, Basu and Rege, 1951), Raheja et al, 1959, Zende and Kibe, 1967, Zende, 1973, Leeper, 1947, Leeper, 1970).

Zende (1979) presented a detailed review of soil status and deficiency symptoms of micronutrients in sugarcane soils of India. Only few States in the country have been able to take up such studies and correlate the growth of sugarcane crop with the supply of micronutrients in them. Data on micronutrient status of sugarcane soils from five States - namely - Andhra Pradesh, Maharashtra, Gujarat, Bihar and

Karnataka are readily available and have been presented in Tables 25 to 32 (and also in earlier Tables 19 & 21).

The micronutrient status of sugarcane soils from Andhra Pradesh is depicted in Table 25. There is a tremendous variation in the supply of different micronutrients - namely - zinc, copper, iron and manganese in soils from different districts of Andhra Pradesh. Soils from West Godavari, Nagarjun Sagar Project area and Guntur districts appear to be high in their supply of micronutrients as compared to other districts while soils from Nalgonda show the lowest status of all the four micronutrients studied.

The six major soil types from three canal areas - namely - Nira Canal, Godavari Canal and Pravara Canals - from D. C. A. of Maharashtra were studied for the status of different fractions of manganese in them. The data obtained are reproduced in Table 26.

Amongst the six soil types, C type showed higher status of exchangeable manganese in Nira and Pravara canal areas, while soil types A, F and C showed higher status of reducible and active manganese in all the three canals.

Sugarcane soils from Pune district of Maharashtra were studied for their contents of all the six micronutrients in an available form. The range values and the mean values are reproduced in Table 27.

On average value basis, the sugarcane soils from Pune district appear to be well supplied with all the six micronutrients present in them.

Information on sulphur status of soils is very scanty and is restricted to few States only. The status of sulphur in four different forms from 5 locations representing five agroclimatic zones of Maharashtra State is illustrated in Table 28.

It is noted that the bulk of sulphur is present in the form of organic sulphur and water insoluble inorganic sulphur. Dapoli soil is rich in organic fraction of sulphur, while Akola soil is rich in water insoluble inorganic fraction of sulphur.

The effect of parent material on the manganese status of soils from few research centres in Andhra Pradesh and Maharashtra is indicated in the data reproduced in Table 29. It is interesting to note that the alluvium material shows higher status of manganese than the Deccan trap material or Gneissic complex.

The micronutrient status of soils from Gujarat State and varying in texture is reported in Table 30. The soils in general appear to be well supplied with all the four micronutrients inspite of variation in soil texture. When these values are compared with those from Pune district (Table 27) the Gujarat soils appear to be lower in status for the respective fractions of four micronutrients.

The micronutrient status of sugarcane soils from North and South Bihar and 10 farms of Harinagar Sugar Factory is reported in Table 31 and Table 21 respectively.

It is interesting to note that North Bihar soils are higher in exchangeable fraction of manganese in them than South Bihar soils but in respect of other fractions of manganese and total iron, South Bihar soils show a much higher status. The soils from few farms of Harinagar Sugar Factory (Table 21) indicate deficiency of Zinc or Copper or Manganese in them. The distribution pattern of different fractions of manganese in different horizons of a soil profile in 3 soil types of alluvium soil division of Bihar is depicted in Table 32. It is seen that the level of exchangeable manganese shows a decline with increase in soil depth, while reducible and active fractions in general show an increase with increase in soil depth in 2 out of 3 soil types. Water soluble fraction of manganese shows the highest level in the second horizon of sandy and sandy clay loam soil types. In respect of sandy loam soil, the third horizon shows the highest level of water soluble fraction of manganese.

Manganese status of sugarcane soils from three sugar factory areas in Karnataka State is prescribed in Table 21. It is noted that sugar soils from all the three factory areas are well supplied with exchangeable and reducible fractions of soil manganese.

Problems Posed in Management of Sugarcane Soils

Soils under sugarcane cultivation pose a variety of problems in their management based on their differences in physico-chemical characteristics, climatic conditions of the region and inadequate supply of water during the active period of crop growth. Some are natural problems while others are manmade or due to ignorance of scientific method of cane cultivation. The main problems generally faced by sugarcane growers in different soil types have been outlined by Zende (1981) and can be broadly listed as under :

- (1) Highly compact soil - no aeration - restricted root growth, imbalance in air - water relationship.
- (2) Soils highly calcareous or highly alkaline in reaction posing a problem of inadequate supply of nutrients in them - iron chlorosis.
- (3) Soils low in fertility - low in organic matter - rate of availability of nutrients in the soil is very low.
- (4) Very deep soils or very shallow soils - surface run off or excess drainage.
- (5) No response to P and K fertilizers - high fixation of P and K in soils - imbalance in the use of P and K by cane crop.
- (6) Improper method of fertilizer application.

- (7) Inadequate mineralisation of added nitrogenous fertilizers.
 - (8) Losses of nutrients through leaching, volatilization or denitrification.
 - (9) Water Supply inadequate - No mulching done - No efforts to conserve soil moisture.
 - (10) Inadequate tillage - Ratoon crop neglected.
 - (11) Lodging in cane - due to excessive use of nitrogen or inadequate supply of K fertilizers.
 - (12) Inadequate use of bulky manures - deterioration in soil fertility and soil structure.
 - (13) Imbalance in the use of NPK fertilizers - tendency to apply only nitrogenous fertilizers.
 - (14) Inadequate weed control - crop growth adversely affected.
 - (15) Inadequate pest and disease control - crop growth adversely affected.
 - (16) Inadequate measures for reclamation of acid, saline and alkali soils.
 - (17) Soils ill drained - High water table - restricted root growth.
 - (18) Deficiency of micronutrients or sulphur or silicon.
 - (19) High proportion of exchangeable magnesium in soils - poor structure, lower rate of mineralization.
 - (20) Cane after cane - no suitable crop rotation - Soil does not get any rest.
 - (21) Ignorance about changes in soil properties under intensive cane cultivation.
 - (22) No record of soil fertility status.
 - (23) Saline well waters.
 - (24) Inadequate attention to levelling of lands, graded furrow or contour furrow method of cultivation.
 - (25) Negligence in the use of good and vigorous seed.
 - (26) Delay in tillage and inter culturing operations.
 - (27) Excessive use of canal water - adverse effect on soil temperature, air water balance and microbial activity.
 - (28) Stunted crop growth - no knowledge about nutrient deficiency symptoms.
 - (29) No scientific planning in cultivation practices - no record of specific operations or observations.
 - (30) Soils highly saline.
 - (31) No efforts to build up or maintain soil fertility.
 - (32) Restricted drainage - difficulty in cane cultivation due to soils setting hard on drying due to cementing action.
 - (33) Light textured soils low in moisture holding capacity, poor in fertility - tendency for heavy leaching of nutrients and no proper root hold.
 - (34) Heavy textured deep soils - poor rate of infiltration - no surface drainage provided - big clods not broken by disc harrow.
 - (35) Heavy textured soils with high content of free lime - drainage rather poor, seepage problem, water logged areas.
 - (36) Soils subjected to frequent river floods. High water table during July to November, crop gets submerged.
 - (37) Sand deposited during flood period, high compaction in soil closeness of river.
 - (38) Tillage operations under wet conditions - adverse effect on physical condition of the soil.
 - (39) Use of heavy machinery - soils get compacted.
 - (40) Maintenance of soil fertility.
- Economic production of sugarcane would depend upon the sincere efforts made in cultivating the soil after considering its defects and adopting suitable measures to rectify them speedily.
- Soil Changes and Crop Behaviour in different soil types and under different management practices**
- Sugarcane crop has a high demand for water throughout the crop growth period. Soil has to meet this demand and make available adequate water during different phases of crop growth. Soils from different agroclimatic zones differ in their physico-chemical characteristics and therefore indirectly in their water retention and percent water available in each horizon. Thus, the total water available in a profile in each soil type in a given agroclimatic zone varies considerably. This could be very well seen from the data reported in Table 33.
- Soils from Rahuri (Ahmednagar district), Mangalvedha (Solapur district) and Pune show a high proportion of available water in the profile and least in Chandgad (Kolhapur district) and Mahabaleshwar (Satara district) soils. This variation in the total quantum of profile water influences the water management policy to be adopted in a given situation in relation to rainfall pattern and irrigation resource available.
- Soils high in status of free lime pose a serious problem of P fixation thereby affecting the supply of P in an available form. Since root activity, cane quality and nitrogen and potash nutrition of sugarcane crop is governed by P supply in the soil, knowledge about the degree of P fixation and level of available phosphate in a given soil assumes considerable importance. The

relative fixation rate of P in different soil types of Deccan canal area and its impact on the level of available P_2O_5 in the soil at different levels of fertilizer added is illustrated in Table 34.

It is revealed that the rate of fixation of added phosphate is very high in all soil types and the actual level of P_2O_5 in the available form depends upon the characteristics of soil type, level of free lime and the quantity of phosphatic fertilizer added per acre. Soil types A, G and F show comparatively higher supply of available phosphate in them, the least supply being in C type of soil. While cultivating sugarcane in C type of soil, this fact has to be kept in mind and suitable agronomic practices have to be adopted to improve the phosphate supply in the soil.

Like phosphate, potassium also gets fixed in the soil, the mechanism of fixation being quite different in two cases. Higher the rate of fixation, lesser is the supply of K in the available form in the respective soil type. An idea about the percent K fixation capacity of few locations in different parts of the country and few places in Maharashtra State can be had from the data reproduced in Table 35.

Soils in Assam, Pusa and Coimbatore locations show a very high fixation capacity and the least degree of fixation is observed in soils at Belgaum and Hyderabad. In Maharashtra State, high amount of K is fixed in soils at Digraj (Sangli district), Solapur and Parbhani. Comparatively lower fixation is noted in the soil at Nandgaon in Nasik district.

K characteristics of different soil orders are illustrated in Table 36.

It is observed that Aridisols and Alfisols show higher K saturation, higher isotopically exchangeable K but lower level of exchangeable K (IN Am. Acetate) and exchangeable K in concentrated sulphuric acid. These are light textured soils and have very low C.E.C. Values. On the basis of chemical potential [Δ GK(Cal/Mole)], all values above -3400 indicate presence of K deficiency in the respective soil. Both Alfisols and Vertisols are supposed to exhibit K deficiency in them.

Jafri (1983) studied the availability index of soil K in few locations from eight different States. These values are reported in Table 37.

It is noticed that soils from Coimbatore, Lucknow, Ratnagiri and Thiruvella showed higher fractions of K in each category. Cuddalore and Lauriya showed the lowest level of K fractions under each category. Since drought resistance, better cane quality and nullification of the effect of excess supply of N are linked up with the level of K absorbed by sugarcane crop and indirectly with the level of available K in the soil,

knowledge about the K status of soil assumes special significance in drought-prone areas.

Deep ploughing is an important operation connected with the land preparation programme or preparatory tillage. One of the major advantage of deep ploughing of soils is increased cane production per acre with further improvement in juice quality as illustrated by the data reproduced in Table 38.

In compact deep black soil, chiselling is an important operation, since it enhances cane yield per acre due to improvement in physical parameters of the soil. Application of Gypsum or FYM along with chiselling operation enhances the cane yield still further. This is very well illustrated by the data incorporated in Table 39 for two locations.

Ratooning is an important practice in cane cultivation. It has got economic importance in view of reduction in cost of cultivation of sugarcane. Cane-growers are tempted to take more than one ratoon for economic reasons. However, taking more than one ratoon has an adverse effect on physical fertility of the soil. Effect of taking more than one ratoon on the physical parameters of soil (namely - average bulk density and percentage pore space distribution at different depths) is narrated in Table 40.

It is revealed that growing three ratoons in sequence is a harmful practice in view of increase in bulk density and reduction in percentage pore space. The worst effect is noticed after third ratoon. Further, the deterioration in physical fertility is seen in all depths of the profile. This has to be avoided either by adopting better management practices or not taking more than one or two ratoon crops.

Cropping system adopted has a considerable influence on the physical condition of the soil - Table 41. Manuring of cane helps to arrest the decline in physical parameters. In this respect, Adsali and Ratoon crops duly manured help to maintain the soil in a better physical condition. Keeping the soil fallow does not help much if it is cultivated or irrigated. The effect in general is however unpredictable.

Soil types differ in their fertility status and therefore in their crop yield potential. The data on performance of CO 419 in 5 different soil types of Deccan canal area in Maharashtra State is reported in Table 42. It is clearly seen that the performance of sugarcane crop was considerably influenced by climatic conditions prevalent in different planting seasons, but for the same season, soil type A produced the best effect on crop yield followed by B, G and D. The least effect was seen in F type of soil. In view of variation in genetic potential, different varieties when grown in the same soil type, they differ considerably

in their yield performance. This can be clearly seen from the data for 1956-58 season also reported in Table 42. All varieties yielded much better when grown in D type of soil, the average for all varieties together being 83.4 M.T./acre followed by B type (67.6 M.T./acre) and G type (60.2 M.T./acre). F type again showed the least performance either in respect of individual varieties or average of all varieties together. Thus soil type, variety and season of planting show a strong interaction with each other and impose limitations in achieving maximum yield in different combinations.

The popular method of reclaiming saline alkali soil is to apply Gypsum or Dhaincha or both. The application of dhaincha alongwith Gypsum accelerates the effect of Gypsum in bringing about an improvement in all chemical parameters of a saline alkaline soil. This is very well illustrated from the data reproduced in Table 43. The overall effect is much better than after 2 years.

The general schedule to be followed for management and reclamation of saline or alkali soils is specified by Zende (1968 and 1981). The main features of this approach envisages attention to (i) addition of organic matter, (ii) care in water management, (iii) adoption of suitable cultural practices, (iv) improvement in soil fertility, (v) provision of adequate drainage, and (vi) choice of varieties.

Based on cost involved, chemical amendments used for reclaiming saline or alkali soils are not always economically beneficial. Use of agricultural waste material for bringing about an improvement in a saline soil is probably the practical alternative. Relative improvement brought about in salinity by using agricultural waste material is depicted in Table 44. Use of Tamarind seed powder produced the best effect followed by safflower hulls and ground-nut hulls. With increasing salinity in the soil, there is a reduction in sheath moisture, N, P, K, Fe, Mn and Zn content in the leaves. Increase in soil salinity produces a detrimental effect on the yield of an Adsali crop. (Patil et al., 1983). Similar effect is seen in case of ratoon crop (Patil and Zende, 1983). Varietal, cultural, irrigation and manurial trials were conducted in each soil type to study its behaviour under different management practices. These studies were found to be very useful in judging the behaviour of individual soil types. (Joshi and Mahajan, 1964; Dani and Joshi, 1965; Zende, 1970).

Crop yields could be positively improved through fertilizer application. However, the significance of balanced fertilization is not adequately realised by all sugarcane growers. Srivastava and Shukla (1986) recently brought out additional information on this aspect to confirm the main theme. Their data for four locations in U. P. are reproduced in Table 45.

It is revealed that balanced application of N P K fertilizers based on soil test values resulted not only in getting higher number of millable canes per hectare but also in getting higher cane yield at all the four locations in U. P. The actual increase in cane yield due to balanced manuring was in inverse proportion to the original level of available N in the soil.

The observations made by Sharanappa et al, 1977 in lateritic soils of Bidar in N. E. Karnataka were also interesting. They noted that P_2O_5 and K_2O application increased the cane yield and improved the juice quality. Increase in cane yield was more with the application of P_2O_5 than K_2O , while the juice quality was better with K_2O than P_2O_5 . The response of black, red, lateritic and alluvial soils to P and K application needs to be studied more critically for working out suitable package of practice.

Soil Fertility Changes and its Overall Impact on Crop Growth

Soil health and soil fertility go hand in hand. Their maintenance at optimum level usually does not receive full attention in almost all parts of the country. Poor soil and water management is one of the limiting factors for achieving higher crop yields with optimum quality. The sugarcane crop requires a well prepared, well structural and well aerated soil profile to a depth of about 50-60 cm without compaction or hard pan or salt zone in the sub-soil. Total porosity should be at least 50 percent with pore size distribution as large pores, medium pores and fine pores in the ratio of 1:1:1 (Stefanhusz, 1972, Zende, 1984).

In practice, it is difficult to build up soil fertility in tropical soils under intensive system of cane cultivation. So, efforts have to be made to maintain the level of fertility as best as possible with available resources and suitable soil and crop management practices. Some of the efforts made by few workers in the said direction are outlined in brief to throw some light on this aspect.

Organic manures, when they are applied to the soil, bring about a positive change in soil fertility status. The relative effect of each source of organic manure on fertility parameters varies from source to source. A comparative data collected by Mirajkar et al, 1956 is reproduced in Table 46.

Amongst the three sources of organic manures, F. Y. M. produced the best effect in respect of organic carbon, total nitrogen, percent rate of nitrogen release, available phosphate and available potash. Between Sannhemp (as a G. M.) and Safflower cake, Sannhemp was better than Safflower cake in respect of organic carbon status and the percent rate of N released. Sulphate of ammonia as a source of inorganic N was better than other treatments (except F Y M) in respect of

total status of the soil.

Continuous application of FYM for years together bring about a substantial enrichment in respect of total N, organic carbon, available phosphate and available potash. This beneficial effect is comparatively higher over dry control than over irrigated control as seen from the data reported in Table 47 A.

When FYM cannot be applied in adequate amounts, one has to think of alternative sources of organic waste material which also help in bring about the desired improvement in fertility status of the soil. The data reproduced in Table 47-B clearly suggests that application of Rice husk, Groundnut shells, Wheat straw and Rice straw can produce better effect than FYM in respect of all the parameters studied.

Like FYM, compost is also an effective source of organic manure which helps in building up the soil fertility. The relative difference in the fertility build up in treated and untreated plots after a long period is well documented in Table 48.

Sugarcane planted as a plant cane or Adsali cane or their ratoon induces changes in soil properties. The effect depends upon the type of planting and whether the crop is manured or otherwise. Adsali manured and Ratoon manured produced better effects than plant cane manured. In all cases, unmanured plots showed soil fertility of lower order. This can be seen from the data reported in Table 49.

The sugarcane yield is directly related to level of soil fertility. The effect of addition of N P K fertilizers in such situations modify the effect of treatment. The linear relationship between the level of soil fertility and cane yield is well illustrated in Table 50.

Soil fertility is an integral property of soil and is generally assessed from mineral nutrient content. Soil productivity - on the other hand - is influenced by physical, chemical and biological factors of soil in which the crop is raised and managed. Soil management therefore aims at keeping the soil at optimum condition for the crop to be raised (Zende, 1981). Apart from the positive aspect of providing favourable soil factors for growth, the negative or destructive aspects such as weeds that compete for nutrients with the regular crop and soil salinity, alkalinity or acidity and soil borne pathogenes etc. which adversely affect the crop growth, are also to be taken care of. (Parthasarathy, 1972; Parthasarathy et al, 1979).

Limits of sufficiency and deficiency based on availability indices of N, P and K in soils and plants have been suggested by Jafri, 1983. If the cane farmer gets his soil analysed before taking up a sugarcane crop, he will be able to know himself the position of his soil in terms of fertility status. The data compiled

by Jafri, 1983 is reproduced in Table 51.

With the change in fertility status of the soil, plant indices also show a corresponding change in their values, resulting in differential yield potential as seen earlier (Table 50). Lucerne, cowpea, dhaincha, peas and sann hemp are found to be effective in increasing the soil fertility where grown as inter crops in sugarcane. Acharya et al, (1953a, 1953b) noted that growing of a legume (Berseem) in rotation helps in building up the soil fertility both in respect of organic matter as well as phosphate and N in the soils.

A Bird's Eye View of Soil, Fertilizer and Water Management Approach in Sugarcane Soils

Sugarcane soils from different regions of the country differ considerably in their physico chemical characteristics. They pose variety of problems in their management. Soil management therefore aims at keeping the soil at optimum condition for the sugarcane crop to be raised. A sugarcane crop requires well-prepared, well-structured and well-aerated soil profile to a depth of about 60 cm. without compaction or hard pan. The cultural and manurial practices need to be modified to suit each soil type.

Sub soiling is a pre-requisite in soils which tend to show compaction. In every soil, drainage should be normal. Land levelling is perhaps the most neglected items in irrigated farming. Deep ploughing to a depth of 45 cm induces better root development. Tillage operations alter the soil structure. Soil should exhibit granular structure. Provision of drains to lower the water table is an essential feature for getting optimum yields. Preservation of good tilth of the soil is a master key in sugarcane production. (Zende, 1981)

Large areas in different States have gone out of cultivation due to salinity or alkalinity or both. In most cases, these lands were basically fertile and good. Salinity, alkalinity and water logging impairs the functioning of sugarcane roots. They could be improved by effective drainage, crop rotations and use of chemical amendments.

Better root activity encourages higher absorption of nutrients resulting in higher cane yields. A definite schedule for reclamation of saline or alkali soil has to be followed for getting higher yield in specific situations. (Zende, 1968).

In States like Maharashtra, Gujarath, Karnataka, Madhya Pradesh, Andhra Pradesh etc. there is a stagnation in cane yield potential. The technology based on chemical and varietal approach is quite effective and adequate for getting potential maximum yield in all the regions indicated above. The response to chemical technology, however, becomes limited in the absence of bio-physical basis of soil management in all localities.

(Zende, 1983). In this respect, following care is emphasized : (i) Application of well decomposed organic manure every year to the tune of 5 M.T./acre or growing a green manure crop and burying it alongwith adequate dose of phosphate, (ii) Growing aleguminuous crop in rotation, (iii) Use of Azotobacter, Cellulotic fungi and Mycoriza as cultures, (iv) 25-50 percent of higher dose of phosphate than what is generally recommended, (v) Preparing compost from trash and applying it to the soil, (vi) Care in tillage operations.

Fertilizers are powerful soil management tools and can make effective contribution to crop production only when all other production factors are in reasonable balance and receive appropriate attention. To derive full benefit from the application of fertilizers, it is essential to determine the ability of the soil to supply the nutrients to the crop and the rate at which the nutrient in question is made available to the crop under field conditions. For every nutrient applied through a fertilizer, there is a critical limit below which the crop shows deficiency symptoms and above which there may not be any response to application of nutrients through fertilizers. Under optimum conditions of growth, tissue indices play an important role in making economic use of fertilizers. A common dose of fertilizer applied to all varieties will not be fully effective and will not give economic returns. Early application of N at planting along with P_2O_5 and K_2O gives higher yield of sugarcane with better juice quality than piece meal application. Nitrogen is the only major element to which sugarcane responds consistently almost universally.

Inhibition of nitrification process could be achieved by using agro-chemicals and pesticides like gamma B H C, Teludrin, AM, ST, Neem cake, castor cake, neem oil, endo-Sulphon, Karanj cake, N-Serve, Dildin etc. The efficiency of these products depends upon the initial fertility of the soil.

Efficacy of fertilizer depends upon its placement, form and dose applied. Application of fertilizers based on soil test values not only gives higher yield of cane due to balanced use of NPK but there is also a saving in the cost of fertilizers due to reduction in the dose to be applied.

The practice of applying large quantities of bulky manures to soils keep the land well supplied with micro-nutrients. A judicious combination of organic manures with inorganic fertilizers increases the crop yield. There is a need to make maximum possible use of bulky manures in case of cultivation. Press-mud cake, green manure, compost, FYM are all good sources of organic matter and should be used extensively with normal care. For light and heavy soils, fertilizer recommendations based on six tier system offer a

great promise if certain precautions are taken simultaneously. (Zende, 1982, 1984). A practical approach for increasing the sugarcane yield in different soil types has been advocated by Zende (1976).

Water is an essential input in sugarcane production. Increased production depends upon its efficient use throughout the growing season of the crop. For increasing the water use efficiency, it is necessary to pay attention to minimising losses through evaporation, transpiration and leaching. Excess supply of water or deficiency in the supply of water, both limit the cane yield. The amount of water utilised by a sugarcane crop has a linear relationship with the total dry matter produced. Salinity in the soil reduces the water intake and consequently the cane yield. Water retention and transmission characteristics of a soil determine the amount of water available to plant roots. Plants use water only from the root zone. Water which goes deeper into the soil than the roots of the crop is practically wasted. Deep black soils have low infiltration rate and poor permeability. Open pan evaporation can be used as a good guide for scheduling the irrigation. Water stress produces metabolic changes in plants, particularly that of nitrate reductase activity. Sugarcane varieties show wide variation in their water requirements. While irrigating the crop, uniform distribution of water over the entire field is very essential to derive maximum benefit. Lift, Drip and Sprinkler irrigation systems can be made successful with planned efforts in their execution.

A combination of (i) long furrow method of application, (ii) water dose based on CPE value of 50-75 mm per turn, (iii) suitable depth of irrigation, (iv) interval of irrigation suitable to phase requirements, (v) land levelling, land shaping, (vi) use of mulch and anti-transpirants to minimise evaporation and transpiration losses, and (vii) maintenance of pumps and water distribution channels in good condition can go a long way in achieving the best results (Zende, 1983) (Zende, 1977).

An interrelationship between irrigation, manuring and kind of planting has been studied by Zende (1976). It was observed that individual contribution of N dose alone or different irrigation levels alone is either nil or non-significant. When these two factors are combined together, they show a favourable effect indicating an inter-action between the two factors. The type of planting makes a substantial contribution in deciding the yield response. The cane yield obtained under each combination of N dose, irrigation level and type of planting is further dependent on the level of soil fertility of each soil type and the climate. Lot of advances have been made recently in sugarcane Agronomy with special reference to soil characters (Zende, 1973).

Correlation between Soil and Agronomic Parameters

When soil parameters create a favourable or unfavourable environment it reflects on growth parameters and ultimately on crop yield. Such studies have been carried out extensively on all crops. Sugarcane is not an exception to this. Zende (1974, 1983), Patil and Zende (1980), and Zende and Bhanavase (1981) studied the correlation between soil and agronomic parameters. Their observations are reproduced in Table 52.

It is seen that the level of $\text{NO}_3\text{-H}$ in the soil in the months of November and June showed a significant correlation with cane yield of an Adsali crop. Similarly, levels of available N, P and K in the soil showed highly significant correlation with the nutrient level in the plant at 5 months of crop age and at harvest respectively. The level of micro-nutrients in the soil (namely Fe, Mn and Zn) showed significant correlation with Adsali and ratoon yield of a sugarcane crop. The level of organic carbon in the soil showed a positive and significant effect on cane yield, while in respect of available phosphate in the soil, it had positive significant effect at Ratoon Yield.

The soil salinity usually has a negative influence on plant parameters. The significance of this influence was studied by Patil et al (1983) and Patil and Zende, (1983). Their observations are reproduced in Table 53. It is noticed that the Ec value of the soil showed significant negative correlation with Mn, Fe and cane yield of an Adsali crop and with Zn and yield in respect of ratoon crop.

Sen (1953) noted a positive correlation between the cane yield and the C/N ratio of soils in a particular zone.

Schedule for cultivation of Sugarcane in different soil types

The sugarcane soils in the Deccan Canal Tract have been classified and grouped into 12 distinct soil types based on profile characters. Area covered under different soil types in D.C.A. is A = 11.4%, B = 30.0%, C = 6.3%, D = 15.9%, F = 4.2% and G = 22.8%. Based on the series of experiments conducted on each soil type for a period over 10-15 years, a schedule for cane cultivation (management of sugarcane crop in each soil type) has been formulated. (Patil, 1955, Joshi, 1967, Dakshindas and Joshi, 1962, Zende, 1981, Dani and Joshi, 1965, Joshi and Mahajan, 1964). Zende 1986 emphasized to follow these schedules rigidly for getting optimum cane yield.

Epilogue

Sugarcane soils in India differ considerably both in their mode of formation, basis of classification, physico-chemical characteristics and their behaviour

under different management practices. Naturally, sugarcane varieties when grown in such soils also show a differential yield potential in view of soil type climate - variety - management inter-actions.

The subject being very vast, it was not possible to do justice to all aspects governing mode of formation and the performance of these soils. However, an attempt was made to point out few basic things about these soils (from as many States as possible) and quote few examples to illustrate their behaviour as briefly as possible. Eventhen the theme has covered an exhaustive ground. It is presumed that the readers of this article will get a glimpse of the overall situation if not an exhaustive picture. No attempt was made to quote all references available on the subject in view of limitations of space. The readers will appreciate the difficulties faced by the author in dealing with the exhaustive theme.

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FIG 1: SOIL CLASSIFICATION CHART
(SUGARCANE SOILS/M.S.)

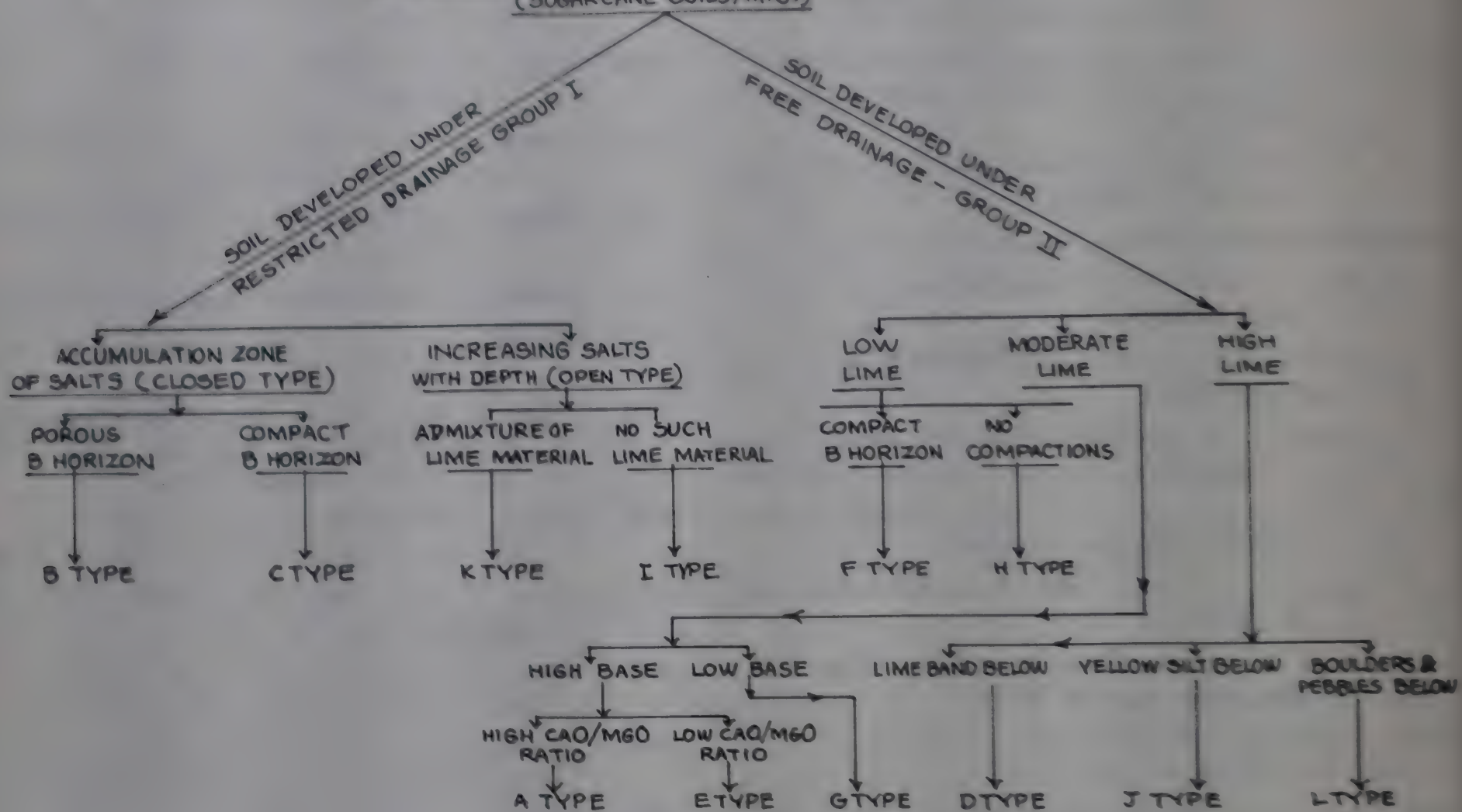


Fig. 2

Topo Sequence of Soils of Deccan Canals

	Group I				Group II				Group III			
	High Level Shallow				Intermediate Medium Deep				Lowlying Dep. Soils			
	G	H	F	E	A	D	K	L	C	I	B	J
Canal	→	→	→	→	→	→	→	→	→	→	→	→
Topography	Flat	Gently sloping	Sharply sloping	Sloping	Gently sloping	Undulating	Sloping	Sharply sloping	Sharply sloping	Mod. sloping	Gently sloping to flat	Gently sloping to flat
Drainage of Substratum	Fair	V. Good	Fair	Inferior	Good	Good	Fair	Inferior	Bad	Good	Good	Good
Sub Soil water Table	Deep	Deep	Deep	Deep	Fairly Near	Fairly Near	Deep	Near	V. near	Fairly Near	Near	Near
Colour	Dark Brown	Reddish Brown	Light Brown	Grayish Black	Black with reddish tinge	Dark Brown Gray	Deep. black	Deep. grayish black	Grayish black	Grayish black	Brownish black	Grayish black
Structure	Granular	Granular	Granular	Crumb	Crumb	Crumb	cloddy	Hard cloddy	Hard lumpy	Nutty	Medium clods	Medium clods
Clay %	52.0	47.0	46.0	60.0	49.0	55.0	44.0	50.0	50.0	50.0	56.0	50.0
CaCO ₃ %	4.0	0.6	1.0	7.0	8.3	9.4	7.0	10.00	4.0	9.3	9.0	8.0
Soil pH	8.3	8.3	8.1	8.6	8.5	8.8	8.5	8.4	8.5	8.7	8.8	8.4
Exch. Ca ⁺⁺ m. e. %	53.0	54.0	57.0	69.0	69.0	53.0	39.0	45.0	45.0	38.0	26.0	35.0

TABLE 1
Important Characteristics of Major Soil Types (D. C. A.)

Soil Attribute/Soil Type	A	B	C	D	F	G
% clay	49.0	50.0	56.0	55.0	46.0	52.0
% CaCO ₃	5.0	8.0	4.0	9.4	1.0	4.0
Soil pH	8.5	8.8	8.8	8.5	8.1	8.3
Exch. Ca ⁺⁺ m.e. %	60.0	35.0	45.0	40.0	45.0	55.0
Exch. Ca ⁺⁺ / Exch. Mg ⁺⁺ ratio	10.0	3.0	3.0	3.0	10.0	3.1
Total N %	0.04	0.048	0.046	0.042	0.058	0.053
Av. P ₂ O ₅ %	0.006	0.005	0.005	0.005	0.01	0.006
Av. K ₂ O %	0.027	0.048	0.02	0.04	0.021	0.024

Krishna Canal and Kolhapur Region (ZENDE, 1970)

Soil Attribute/Soil Type	H	Low Lime B	Alluvial Clays	Red Alluvial	River Border or O Type
% Clay	40.5	50.7	50.6	40.5	25.4
% CaCO ₃	<2.0	1.5	<2.0	Nil	1.5
Soil pH	7.8 - 8.5	8.2 - 8.8	7.0 - 8.2	6.0 - 7.0	8.0 - 8.5
Exch. Ca ⁺⁺ m.e. %	40.5	50.6	25.40	20.4	25.35
Av. P ₂ O ₅ %	0.01	0.005 to 0.01	Less than 0.005	0.005	0.01
Av. K ₂ O %	<0.02	0.02 to 0.03	0.01 to 0.02	0.01 to 0.02	0.01 to 0.03
Total N %	0.5 to 0.06	0.05 to 0.09	0.08 to 0.1	0.08 to 0.12	0.04 to 0.07
Total Salts mmhos cm	<0.03	<0.5	<0.2	<0.2	<0.4
Exch. $\frac{Ca^{++}}{Mg^{++}}$ ratio	>3.0	3.5	3.5	3.5	>5.0
Soil Texture	Loamy	Clayey	Clayey	Loamy	Silt Loam

Table 2
Characteristics of Sugarcane Soils of Maharashtra

Sr. No.	Location	Soil Type	Depth in cms.	Silt %	Clay %	Free Lime %	Total Salt %	pH (Water)	Exch. bases		N %	Total		Available P ₂ O ₅ %
									Ca ⁺⁺	me % Mg ⁺⁺		P ₂ O ₅ %	K ₂ O %	
1.	A. R. S. Lakhmapur Dist. Nasik	F	0-10 10-20	22.5 21.25	45.5 49.0	1.07 1.44	0.39 0.40	8.17 8.05	56.5 58.3	2.34 4.50	0.058 0.056	0.36 0.35	0.187 0.18	0.010 -
2.	Dhoki Dist. Osmanabad	C	0-30 30-60	18.0 17.0	55.75 63.00	3.80 2.67	0.20 0.28	8.53	42.6	9.87	0.067	-	-	0.002
3.	A. R. S. Kopergaon Dist. Ahmednagar	A	More than 0 Meter	-	49.0	5.0	-	8.53	42.67	15.17	-	-	-	0.006
4.	S. R. S. Padegaon Dist. Satara	B	"	-	50.0	8.0	-	8.50	60.0	-	0.04	-	-	0.006
5.	Hol Dist. Pune	C	About a Meter	-	56.0	4.0	-	8.8	35.0	-	0.048	-	-	0.055
6.	A. R. S. Akluj Dist. Solapur	D	" -	-	55.0 to 58.0	9.4	-	8.5 to 9.0	45.0 to 35.0	-	0.046	-	-	0.005
7.	A. R. S. Deolali Pravara Dist. Ahmednagar	G	0.8 Meter	-	52.0 to 56.0	4.0 to 5.0	-	8.8	40.0	-	0.042	-	-	0.005
8.	Lateritic Alluvium Kolhapur	-	-	-	40.0 to 50.0	Less than 1%	-	8.3	55.0 to 57.0	-	0.053	-	-	0.006
9.	Alluvial clays of Flood Plains	G	-	-	50.0 to 60.0	Less than 2%	-	7.0 to 8.2	25.0 to 40.0	-	0.08 to 0.1	-	-	0.005
10.	Krishna Canal Area	B	-	-	60.0 to 70.0	1.00 to 5.0	0.05	8.87	50.0 to 60.0	-	0.07	-	-	0.008

(Ref. - Joshi 1966)

Table 3
Major Soil Types in Sugarcane Growing Districts in Maharashtra

Name of the District/Area	Major Soil Types
1. Sangli District	Soil Type B, Low Lime B, Soil Type U (River Border silt loams) Soil Type H, Soil Type A, Soil Type C
2. Osmanabad District	Soil Type A, Soil Type D, Soil Type C, Soil Type B, Soil Type G
3. Kolhapur District	Residual Lateritic Soil. Lateritic alluvial, Alluvials of flood plains in medium rainfall zone, Residual low lime Black earths of medium rainfall zone, Residual black earth of low rainfall zone.
4. Krishna Canal	Low lime B or alluvial clays. Saline alkaline phase of B. River border silt loams (U Type) High level, low lime, shallow, reddish brown loams (H Type) B Type (Black clay loams)
5. Dhulia District	Soil Type H, Soil Type A, Soil Type D, Soil Type B Eroded B, Soil Type U.
6. Buldhana District	Soil Type G, Soil Type D, Soil Type A, Soil Type B, Soil Type C, Soil Type U.

G = High Level, Moderate Lime, Shallow, Brown Clay Loams.
D = Intermediate, calc, medium deep, dark brown, clay loam.
A = Intermediate, medium deep, moderate lime, black clays with reddish tinge.
B = Low laying, moderate-lime, deep, brown black clays.
C = Low lying, deep, black, compact clays.
U = River or Nala border silt loams.
H = High level, low lime, shallow, reddish brown.

Ref: (1) Joshi et. al. 1962 - D. S. T. A. 18th Convention P. 245.
(2) " 1964 - D. S. T. A. 19th Convention P. 145.
(3) " 1961 - J. India Soc. Soil Sci 9(3) P. 157
(4) " 1964 - D. S. T. A. 19th Convention P. 155.
(5) " 1969 - D. S. T. A. 23rd Convention P. 35.
(6) " 1967 - D. S. T. A. 22nd Convention P. 11.

Table 4
Characteristics of a Saline/Alkali Profile (Baramati M. S.)

Soil Type	Soil depth Soil Property	0-15 cm	16-30 cm	30-60 cm	61-90 cm	91-120 cm	120-150 cm
1. Deep black Saline	% T. S. S.	3.11	2.28	1.82	1.62	1.14	0.85
	Soil pH	7.5	7.70	8.0	8.30	8.5	8.65
	NaCl % on Total	12.30	16.50	12.18	15.9	16.3	13.7
	Na ₂ SO ₄ % Salts	39.6	44.8	48.5	51.4	49.5	53.7
2. Sodiumised black soil - A Type	% T. S. S.	0.24	0.30	0.34	0.58	0.20	0.22
	Soil pH	9.14	9.50	9.44	9.45	9.46	9.48
	% CaCO ₃	11.95	13.75	12.60	11.20	15.60	14.0
	% Monovalent bases	20.16	22.97	19.25	15.4	13.9	20.05
3. An Alkali Profile C Type	% T. S. S.	---	0.42	---	0.53	0.83	0.31
	pH in Water		10.20		9.80	8.60	9.64
	Water Soluble Na ₂ CO ₃ %		0.036		0.056	0.056	0.028

(Ref: Talati R. P. 1941 Indian J. Agric. Sci. 11 P-959-77)

Table 5
Soil Test Summaries - Maharashtra State

Sr. No.	Name of the District	Parker Index		
		Organic Carbon	Phosphate	Potash
1.	Pune	1.84	1.66	2.69
2.	Solapur	1.70	1.72	2.77
3.	Ahmednagar	1.39	1.80	2.78
4.	Aurangabad	1.84	1.74	2.80
5.	Beed	1.83	1.70	2.71
6.	Nanded	1.85	1.68	2.88
7.	Osmanabad	2.01	1.53	2.76
8.	Parbhani	1.88	1.65	2.39
9.	Nagpur	1.37	1.44	2.33
10.	Wardha	1.35	1.40	2.54
11.	Bhandara	1.82	1.45	1.98
12.	Chandrapur	1.45	1.47	2.00
13.	Amravati	1.35	1.25	2.75
14.	Yavatmal	1.45	1.33	2.73
15.	Akola	1.43	1.27	2.71
16.	Buldhana	1.39	1.23	2.63
17.	Dhule	1.89	1.81	2.35
18.	Jalgaon	1.71	1.60	2.33
19.	Nasik	1.88	1.69	2.48
20.	Ratnagiri	2.23	1.45	2.03
21.	Thane	2.26	1.62	2.11
22.	Satara	1.67	1.47	2.30
23.	Raigad	2.12	1.60	2.13
24.	Sangli	1.68	1.39	2.25
25.	Kolhapur	2.14	2.07	1.99

(Ref. Dept. of Agri. A. R. 1980-81 ST. L.)

Table 6
Characteristics of Soils from Gandevi Area (Gujarath State)
(Soil Types - Alluvial Clays, Alluvial Loams, Alluvial Sandy Loams)

Village	Soil depth cm	Clay %	Silt %	% Free Lime	pH	Exchangeable		Available		Total N %
						Ca ⁺⁺	Mg ⁺⁺	P ₂ O ₅	K ₂ O	
Gandevi	0.30	48.0	22.2	2.2	8.5	23.3	11.6	0.03	0.05	-
Ajrai	0.30	47.2	26.5	0.7	8.15	30.0	2.9	0.01	0.02	0.071
Dhhuori	0.30	45.7	21.2	0.6	8.15	32.2	10.1	0.012	0.02	0.115
Degaon	0.30	52.5	23.0	1.8	8.4	33.8	0.6	0.016	0.03	0.116
Amalvad	0.30	35.5	25.7	4.1	8.36	24.0	14.0	0.05	0.02	0.066
Abrania	0.30	41.2	25.0	0.4	8.6	30.0	5.8	0.03	0.06	0.09
Munsad	0.30	55.7	19.0	0.73	7.9	30.8	10.3	0.01	0.03	0.091
Khandesupa	0.30	54.2	21.2	2.2	8.5	36.7	12.8	0.02	0.03	0.087
Dabhalai	0.30	48.0	30.0	1.48	8.25	30.0	12.8	0.009	0.02	0.13
Zervavar	0.30	44.2	17.5	0.06	7.6	26.4	13.2	0.003	0.014	0.07
Tarakuai	0.30	49.7	27.5	1.26	8.13	33.6	13.2	0.015	0.023	0.12
Vasagal	0.30	44.7	24.7	4.3	8.6	39.9	7.0	0.0009	0.018	0.118
Khanjurli	0.30	55.5	14.2	0.91	7.0	21.9	12.8	0.0007	0.02	0.099
Pitha	0.30	36.2	22.2	0.5	7.7	21.9	7.0	0.004	0.002	0.073
Gandevi Factory	0.30	36.2	22.2	1.15	8.3	38.1	7.9	0.05	0.026	0.064

(Ref: Joshi et al 1967 D. S. T. A. 22nd Con. Page 242-250)

Table 7

Physico Chemical Characteristics of Soils from Kodinar Tract (Gujarath State)

Location	Soil Depth cm	F. S. %	Silt %	Clay %	CaCO ₃ %	pH %	Exch. bases		Available		Total N %	Org. Carbon %
							m. e. % CaO	MgO	P ₂ O ₅ %	K ₂ O %		
1. Kodinar River border Silt Loam Goradu	0-30	45.0	20.0	21.0	7.2	8.43	23.2	3.3	0.015	0.08	0.06	0.6
	30-60	52.0	21.0	24.0	8.2	8.50	20.7	4.7	-	-	-	-
	60-90	32.0	28.0	37.0	8.9	8.53	26.1	6.1	-	-	-	-
2. Malbaram Residual Shallow Brown Loamy Soil	0-25	36.8	17.2	28.7	18.5	8.64	25.2	1.5	0.005	0.02	0.07	0.84
	25-52	33.5	16.5	30.0	18.6	8.55	24.2	2.0	-	-	-	-
3. Kadodra Residual Medium deep black Soil	0-32	28.7	21.5	37.0	19.1	8.6	20.7	6.0	0.008	0.06	0.07	0.68
	32-62	26.0	19.2	41.0	18.7	8.5	20.7	3.0	-	-	-	-
	62-95	24.3	21.2	43.0	18.5	8.4	20.7	4.7	-	-	-	-
4. Valadar Residual deep black soil Basalt	0-30	15.6	23.7	52.0	16.8	8.3	46.5	4.8	0.001	0.02	0.10	1.75
	30-60	15.0	22.2	51.0	17.8	8.4	37.1	-	-	-	-	-
	60-95	18.2	23.0	49.0	18.5	8.4	31.1	-	-	-	-	-

(Ref: Joshi et al 1960 D. S. T. A. 17th Conven. P. 194-206)

Table 8

Characteristics of Sugarcane Soils of Bardoli Tract (Gujarath State)

Location	Soil Type	Depth in cm	F. S. %	Silt %	Clay %	CaCO ₃ %	pH	Exch. CaO	MgO	Available		Total N %	Org. C. %
										P ₂ O ₅	K ₂ O		
Ninat	Alluvial Clay (Kyari)	0-30	12.1	16.2	63.7	0.60	8.5	42.0	9.0	0.016	0.04	0.08	0.75
		30-58	12.0	12.5	67.5	0.67	8.2	44.5	8.0	0.015	0.03	0.07	0.57
		58-83	10.0	11.2	68.7	-	8.3	46.0	5.5	0.011	0.03	0.06	0.55
		83-118	9.4	18.7	66.2	0.45	8.2	47.0	7.5	0.009	0.02	0.05	0.47
	Alluvial Loams (Beser)	0-22	27.2	12.5	42.5	0.52	8.5	41.5	6.5	0.024	0.014	0.063	0.58
		22-62	32.5	16.25	35.0	3.02	8.6	41.5	3.0	0.007	0.012	0.043	0.27
Vanesa	-do-	62-92	38.1	21.2	22.5	3.85	8.51	41.0	4.0	0.003	0.011	-	-
		0-30		20.0	41.2	0.72	8.65	29.5	8.0	0.007	0.018	-	0.41
		30-50		21.2	41.2	0.27	8.63	34.5	4.5	0.008	0.012		0.30
		50-70		22.6	37.5	0.25	8.50	37.0	4.0	0.022	0.015		0.24
		70-90		27.0	28.7	0.32	7.93	39.5	3.5	0.030	0.014		0.22
Jundi	Alluvial S. L. to silt loams (Gorat)	0-32	37.1	17.5	37.5	0.67	8.58	30.5	4.0	0.010	0.011	0.05	0.44
		32-64	37.8	18.7	35.0	0.60	8.38	34.0	6.5	0.024	0.009	0.03	0.28
		64-94	58.6	16.2	16.25	0.22	7.84	37.5	6.5	0.026	0.008	-	-
		95-102	60.1	11.2	16.2	2.40	8.30	38.0	6.5	0.010	0.008	-	-
Vyara Farm	High level Low lime Reddish Brown Shallow Soil	0-30	25.3	20.7	48.5	1.31	8.14	32.5	9.0	0.011	0.027	0.05	0.57
		30-	21.8	15.5	20.5	1.13	8.11	36.0	8.0	-	-	-	-
	Low lime deep black Soils	0-30	26.0	19.7	53.5	1.27	8.16	37.0	4.5	0.008	0.02	0.062	0.616
"		30-60	25.6	19.7	53.0	1.79	8.14	34.5	9.5	-	-	-	-
		60-90	33.3	19.0	45.2	1.39	8.09	36.5	13.5	-	-	-	-

(Ref: Joshi et al 1960 D. S. T. A. 17th Convention, P. 207-222)

Table 9

Characteristics of Sugarcane Soils of Gujarat (A. R. S. Vyara)

Location	Depth in cm	Silt %	Clay %	WHC %	Free Lime %	pH	Exch. Ca ⁺⁺	Exch. bases		Available		Total N %	O. C. %
								Mg ⁺⁺	me % Na ⁺	P ₂ O ₅	K ₂ O		
Plot 6E	0-30	19.5	54.7	25.75	1.6	8.38	42.0	8.5	2.94	0.013	0.019	0.05	0.51
	30-60	20.3	59.5	29.65	4.0	8.42	43.2	6.0	2.14	-	-	0.039	0.39
	60-90	15.0	39.5	28.20	17.8	8.45	32.15	4.0	-	-	-	0.009	0.12
Plot 14D	0-30	19.75	53.5	27.75	1.3	8.16	37.0	4.5	1.67	0.008	0.02	0.06	0.61
	30-60	19.75	53.0	29.65	1.8	8.14	34.5	9.5	1.43	-	-	0.04	0.41
Plot B7	0-30	20.75	49.5	26.30	1.31	8.14	32.5	9.0	1.91	0.016	0.027	0.051	0.57
	30-60	15.50	20.50	25.75	1.33	8.11	36.0	8.0	-	-	-	0.016	0.19

(Ref: Joshi and Chavan, 1961 Ind. J. Sug. Res and Dev 5(2) P. 101-110)

Table 10

Composition of Sugarcane Soils at
S. R. S. Anakapalle (A. P.) Soil Types

Particulars	Sandy	Sandy Loam	Loam	Clay Loam
pH (1:5 extract)	7.4	7.2	7.3	7.3
Ex in millimhos/cm	0.066	0.090	0.085	0.087
Total N %	0.04	0.035	0.043	0.054
Organic Carbon %	0.33	0.435	0.390	0.675
Total P ₂ O ₅ %	0.11	0.13	0.087	0.176
Total K ₂ O %	0.188	0.30	0.376	0.36
Available P ₂ O ₅ %	0.007	0.012	0.007	0.009
Available K ₂ O %	0.009	0.017	0.012	0.029
CEC me/100 g	9.3	14.4	22.5	35.9
Available P ₂ O ₅ in kg/ha	155	269	168	208
Available K ₂ O in kg/ha	208	181	269	550

(Ref: Sixty Years of A. R. S. at Anakapalle)

Table 11
Characteristics of Soils from Nizam Sugar Factory Area (A. P.)

Soil Type	Category	Silt + Clay Sand	CaCO ₃ %	Soil pH	Exch. Ca ⁺⁺ m. e. %	Exch. Ca ⁺⁺ / Exch. Mg ⁺⁺	Total N %	Available	C/N	C/N
								P ₂ O ₅ %	K ₂ O %	
Red Soil	I	< 0.5	1	6.8 to 7.2	2-10	3-5	0.03 to 0.05	Tv	Tv	8-10
	II	0.5 to 0.7	1	7.0 to 7.5	8-15	3-5	0.05 to 0.08	< 0.015	.015	10-12
Red Soil	II _a	0.6 to 0.8	1-2	7.0 to 7.8	15-25	3-5	0.05 to 0.08	0.05 to 0.01	0.01 to 0.02	8-12
	II _b	0.6 to 0.8	1-3 in subsid 3-7	7.8 to 8.6	10-20	< 3-0	"	< 0.005		8-12
Black Soil	B _I	1.0 to 1.5	2-4	7.8 to 8.2	30-40	3-5	0.04 to 0.06	0.005 to 0.01	< 0.02	8-12
	B _{II}	1.0 to 1.5	2-4	7.8 to 8.5	25-40	3-5	0.04 to 0.06	0.005 to 0.01	< 0.02	8-12

(Ref: K. V. Joshi, 1958 D. S. T. A. 15th Convention P. 146 - 152)

Table 12
Characteristics of Sugarcane Soils of
3 Districts in Uttar Pradesh

District		Shahjahanpur	Sitapur	Barabanki
Samples Analysed		6497	2956	2488
Soil pH	Neutral	5515	2516	2290
	Acidic	451	195	12
	Alkaline	531	246	186
Available P ₂ O ₅	Low	2183	1004	318
	Medium	2325	961	514
	High	1989	891	1626
Available K ₂ O	Low	1620	860	811
	Medium	3077	1301	987
	High	1800	792	687
Organic Carbon	Low	4818	2261	1637
	Medium	1423	596	769
	High	247	99	82
Nutrient	Organic Carbon	1.30	1.27	1.38
	AV P ₂ O ₅	1.97	1.92	2.31
	AV. K ₂ O	2.03	1.98	1.95

(Ref.: B. Singh, M. Singh and P. Lal, 1971)

Table 13

**Characteristics of Sugar Cane Soils
Muzaffarnagar District (U. P.)**

Particulars	Soil Type III (Loamy Sand)		Soil Type IV (Sandy Loam)		Soil Type IV (Clay Loam)	
	0-20	20-70 cm	0-20	20-35 cm	0-20	20-80 cm
Silt %	14.20	14.60	24.85	17.80	26.08	31.4
Clay %	10.50	12.80	14.85	15.30	17.33	27.51
W. H. C. %	33.63	40.64	43.04	36.35	41.5	40.0
M. E. %	13.36	12.17	27.21	19.61	20.82	23.8
pH	7.8	6.8	7.8	7.5	7.0	7.0
Total Exch.						
Bases m.e. %	10.8	14.0	26.0	15.6	14.4	16.0
Exch.						
Ca me %	8.4	11.2	17.6	7.6	12.0	14.0
Total P ₂ O ₅ %	0.02	0.066	0.145	0.130	0.083	0.042
Total K ₂ O %	0.22	0.30	0.25	0.25	0.50	0.12
Total N %	0.027	0.071	0.09	0.042	0.087	0.057
Total Org.						
Carbon %	0.60	0.40	0.52	0.21	0.64	0.27
C/N	22.2	5.6	5.8	5.0	7.4	4.7

(Ref : Singh and Chatterjee 1958)

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Table 14
Mechanical and physico-chemical properties of Tarai and Bhaba Soils
(Kashipur Zone, Dist. Nainital)

(Foothill soils of U.P.)

Soil Type	Depth in cm	C. S. %	F. S. %	Silt %	Clay %	WHC %	M. E. %	Total Exch bases m.e. %	Ex Ca ⁺⁺ m.e. %	Ex mg m.e. %	Ex Na ⁺⁺ m.e. %	Soil pH
Kashipur Type 1 Soil	0-33	1.3	2.2	58.0	17.0	56.2	34.2	12.64	6.0	5.2	1.44	8.0
	33-49	1.4	3.3	58.2	32.0	65.9	44.9	19.2	9.8	6.0	1.4	7.9
	49-59	4.4	5.5	58.7	26.5	63.9	40.5	15.96	9.2	5.2	1.51	7.7
	Water Table below 83 cm.											
Type 2 Soil	0-17	0.9	36.9	35.8	23.2	50.7	23.2	17.6	14.0	-	-	6.9
	17-30	0.6	42.0	31.0	23.0	41.0	22.6	21.2	14.8	1.2	4.2	7.5
	30-75	0.35	34.0	43.9	19.0	57.4	31.1	15.1	9.2	1.44	4.5	7.2
	Water Table below 103 cm.											
Type 3 Soil	0-21	3.3	79.7	4.5	10.9	32.9	23.2	9.6	3.6	-	-	6.4
	21-49	1.7	74.7	8.2	14.3	35.9	24.3	19.6	12.0	-	-	6.6
	49-119	2.3	79.0	7.0	10.5	35.6	24.1	13.2	6.50	-	-	6.6
Bhaba Soil A	0-21	5.3	15.1	38.2	35.5	53.8	28.1	9.4	7.6	1.4	0.4	7.4
	21-51	12.6	50.6	16.7	15.6	40.4	25.6	7.4	6.4	0.6	0.4	7.5
	51-80	57.6	32.6	1.4	5.8	27.7	9.4	2.8	2.0	0.4	0.44	7.5
	80-85	21.4	59.5	8.7	6.5	35.0	16.0	4.6	3.2	1.2	0.24	7.5
Bhaba Soil B	0-23	10.2	29.1	37.0	17.0	52.7	33.0	12.4	8.8	-	-	7.0
	23-60	8.4	31.3	35.8	19.3	52.9	32.5	11.6	8.4	-	-	6.9
	80-150	13.9	37.5	27.5	19.0	40.4	26.0	7.6	6.0	-	-	6.9
Water Table and boulders below 150 cm.												

(Ref. B. Singh, M. Singh and R. N. Ram 1972 38th Conven. STAI p. 19-28)

	Total N %	Org. C %
Kashipur		
Tara Type I	0.063	0.72 (Surface soil)
	0.038	0.90 (middle layer)
Type II	0.13	0.99
	0.06	0.57
Type III	0.057	0.43
	0.035	0.28
Bhaba Soil A	0.074	0.96
	0.070	0.57
Soil B	0.120	0.90
	0.076	0.74

Table 15
Characteristics of Sugarcane Soils
South Arcot District (Tamil Nadu)

Taluk	Depth cm	Soil pH	Total N %	Lime Status Cad %	CEC me % of Clay	Total Salt %	Available kg / ha		C/N	WHC %
							P	K		
Cuddalore	0.20	6.2	0.022	0.14	85	0.035	12.8	128	6.7	26
S. R. S. Cuddalore	20.60	6.8	0.027	0.24	69	0.070	5.2	160	6.8	42
Tirukovilur	0.30	8.1	0.023	0.15	76	0.10	3.2	104	5.8	27
Kumar- -mangalam	30.60	7.1	0.038	0.09	62	0.10	2.4	72	2.1	23
Vilupuram	0.10	8.1	0.073	0.39	75	0.08	6.4	168	5.4	40
Valavanur	10.50	7.3	0.026	0.34	74	0.09	2.8	88	5.5	38
Viddhaehalam	0.30	8.5	0.058	0.65	84	0.051	4.0	256	5.3	50
Kilparayur	30.60	8.2	0.032	0.38	73	0.070	0.8	224	5.8	51
Kallakurichi	0.30	7.6	0.027	0.27	39	0.10	5.4	112	11.7	34
Vengaram	30.60	7.8	0.033	0.48	55	0.13	4.4	112	8.8	55

(Ref : Govind Iyer et al. 1962)

Table 16
Characteristics of Soils of Madras (Tamil Nadu)

Soil Type	Colour	Texture	WHC %	Porosity	Nutrients			pH	EC
					N	P	K		
Red Soil	Red to Reddish Brown	Loam to Sandy Loam	Fair	Good	+	+	+	5.0	Low
Black Soil	Black	Heavy Clay	Good	Poor	-	+	+	8.5 to 9.5	High
Coastal Alluvium	Brown or Reddish	Variable	Fair	Good	+	+	+	6.0 to 7.0	Low
Delta Soil	Variable mostly dark	Clay or Silt Warm	V. Good	Fair	+	+	+	7.0 to 8.0	Low
Laterite	Red or Reddish Brown	Sandy Loam	Poor	V. Good			+	4.0 to 5.0	Very Low

(Ref : P. V. Ramaiah, 1944, M. A. J. 32 P. 197)

Table 17
Soil Data from Kattur Zone (Tamil Nadu)

Village	pH	EC	Texture	N	P kg /	K acre
Poovalur	7.6	0.39	Clay	38.2	20	153
	7.9	0.56	Sandy	50.9	18	207
Pinnavasal	6.4	0.21	Clay	44.5	12	180
	7.3	0.38	Class	63.6	10	162
Sirumayangudi	7.3	0.47	Clay	44.5	6	149
Adigudi	7.5	0.77	Clay Loam	70.0	1	113
Vazuduyur	7.5	0.77	Clay Loam	38.2	1	99
Komagudi	8.2	0.34	Clay Loam	57.3	17	104
Nagar	7.3	0.38	Clay	51.0	3	158
Mettupatti	7.7	0.17	Clay	51.0	21	216
Mangalam	7.1	1.03	Clay Loam	57.2	14	113
Angarai	6.9	0.39	Clay Loam	44.8	22	144
Angarai	7.1	0.30	Clay	44.5	36	50

(Ref : Parthasarathy and Perumal 1978)

Table 18
Soil Data Siruguppa Zone (Bellary District, Karnataka)

Village	pH	EC	N%	P Kg. per acre	K Kg. per acre
Gorebal	9.1	0.3	0.49	7.0	100
Badarli	8.9	0.3	0.47	Trace	180
Badarli	9.0	0.05	0.22	4.0	200
Sasalmari	8.8	0.3	0.60	15.0	200
Sasalmari	8.8	0.5	0.46	Trace	40
Basapur	8.3	0.4	0.76	10.0	80
Basapur	8.6	0.1	0.27	Trace	180
Sindhanur	7.7	10.9	0.45	5.0	200
Sindhanur	8.4	0.7	0.36	5.0	64
Turvihal	8.9	0.3	0.14	Trace	100
Hosalli	8.4	0.4	0.52	9.0	200
Sultanpur	8.9	0.3	0.30	Trace	68
Venkateshwara Camp	8.1	1.3	0.42	11.0	120
Mallapur	9.0	0.2	0.36	Trace	40
Mallapur	8.8	0.3	1.06	Trace	200

(Ref : Parthasarathy and Perumal, 1978 KSC Publication)

Table 19

**Characteristics of Sugarcane Soils of
Belgaum District (Karnataka State)**

Factory Zone	Soil pH	% Organic Carbon	Available P Kg/ha	Free Lime %	Exch. Mn	Reducible Mn
					----- ppm -----	-----
Ugar Sugar Factory	8.1 to 9.0	0.4 to 1.36	3.0 to 13.0	1.1 to 1.51	2.0 to 10	315 to 336
Sankeshwar Sugar Factory	7.8 to 9.5	0.49 to 1.95	1.2 to 28.4	0.8 to 9.64	1.5 to 12.3	195 to 1080
M. K. Hubali Coop. Sugar Factory	5.8 to 9.3	0.4 to 1.6	2.2 to 20.0	0.5 to 1.41	2.0 to 52.0	183 to 795

(Ref : Mithyentha et al 1971)

Table 20

Soil Features of Different Sugarcane Growing Tracts of Bihar

Places	Nature of Soil	Soil pH	CaO %	Organic Carbon %	Nitrogen %	C/N	mg. of N per 100 gm. soil		% Nitrogen released
							NH ₃ -N	NO ₃ -N	
North Bihar									
Harinagar	Non Calc	7.3	0.87	0.54	0.046	11.4	0.94	2.15	6.71
	Alkaline	8.4	1.15	0.45	0.059	7.4	0.90	1.13	3.44
Narkatiya-ganj	Non Calc	7.4	0.44	0.50	0.053	10.1	1.39	2.02	6.43
Maghaulia	Non Calc	7.5	2.96	0.59	0.064	9.6	1.05	3.29	6.78
	Calc	8.2	22.20	0.30	0.049	6.2	2.06	2.70	7.67
Motihari	Calc	8.2	13.20	0.43	0.044	9.9	1.27	1.41	6.09
Motipur	Calc	8.3	24.40	0.39	0.052	7.4	0.58	2.55	6.13
	Non Calc	7.9	5.75	0.36	0.045	8.0	1.92	2.93	8.67
Pusa	Calc	8.2	16.8	0.38	0.05	7.6	1.77	2.55	8.64
Riga	Non Calc	8.0	1.06	0.32	0.044	7.5	0.51	2.36	6.53
Lohat	Non Calc	7.5	0.45	0.51	0.056	9.1	0.86	2.09	5.27
	Alkaline	8.4	0.54	0.37	0.055	6.7	0.52	1.31	3.33
Sitalpur	Non Calc	7.5	2.98	0.54	0.058	9.4	1.06	2.47	6.09
	Calc	8.3	7.91	0.49	0.063	7.0	0.59	2.69	5.21
Pachrukhi	Calc	8.2	14.7	0.35	0.046	8.5	0.90	1.92	6.88
Siwan	Alkaline	8.5	2.4	0.40	0.064	6.6	0.78	1.22	3.13
Hathua	Calc	8.1	5.95	0.60	0.064	9.2	1.13	2.56	5.73
Marhawrah	Calc	8.2	14.50	0.43	0.070	6.14	1.05	1.95	6.98
Patna	Non Calc	7.4	0.78	0.51	0.046	11.50	1.04	1.73	6.02
Ranchi	Acid	6.5	0.85	0.16	0.045	15.0	1.48	1.87	7.44
Alkali Soil	Alk	9.7	0.98	0.30	0.049	6.38	0.81	0.75	3.18

(Ref : S. C. Sen, 1953 J. Indian Soc. Soil Sci. 1 (2) p. 89-94)

Table 21
Characteristics of Sugarcane Soils at Harinagar Farms (Bihar)

Location	pH Range	EC Range	% O. C. Range	Available		Micronutrients (in ppm)			
				P ₂ O ₅ Range	K ₂ O Range	Fe	Mn	Zn	Cu
Banjaria	6.1 to 8.9	0.15 to 0.25	0.14 to 0.55	8 to 110	50 to 156	40.0	11.2	1.0	3.17
Bhavanipur	6.3 to 8.4	0.15 to 0.30	0.25 to 0.74	16 to 35	37 to 150	86.0	26.0	<u>0.35</u>	2.25
Beloura	7.3 to 8.8	0.15 to 0.40	0.17 to 0.75	13 to 110	50 to 167	82.0	8.2	<u>0.35</u>	2.50
Bahurava	7.3 to 9.7	0.15 to 0.80	0.14 to 0.75	11 to 110	68 to 437	98.0	<u>6.1</u>	<u>0.35</u>	<u>0.25</u>
Gonra	7.5 to 10.5	0.15 to 0.60	0.10 to 0.79	13 to 110	35 to 606	38.0	6.4	1.05	<u>0.25</u>
Harepur	7.0 to 8.9	0.15 to 0.30	0.25 to 0.79	19 to 110	37 to 131	72.0	4.2	0.70	2.50
Jabaka	7.0 to 8.7	0.15 to 1.2	0.17 to 1.08	16 to 110	43 to 262	26.0	11.2	<u>0.35</u>	1.87
Pathari	6.3 to 8.8	0.15 to 0.60	0.17 to 0.75	11 to 110	37.6 to 350	48.0	16.0	<u>0.35</u>	2.0
Patilhar	7.0 to 10.5	0.15 to 0.8	0.10 to 0.82	16 to 93	43 to 375	46.0	4.0	<u>0.35</u>	0.75
Shrirampur	7.4 to 8.7	0.15 to 0.20	0.14 to 0.55	11 to 110	31 to 112	25.5 to 29.0	8.1 to 1.6	1.0 to 0.75	2.0 to 1.85

Table 22

**Characteristics of Soils from
Rayagada (Orissa) Canebelt**

Coarse Sand	39.4 %
Fine Sand	35.0 %
Silt	8.1 %
Clay	13.2 %
CaCO ₃	2.3 %
True Density	1.62
% Pore Space	19.2
Organic Carbon	0.175
C/N Ratio	45
pH	5.8
Exch. Ca ⁺⁺ m. e. %	0.15
Total B E C m. e. %	35.1
Av. K ₂ O	0.03
Av. P ₂ O ₅	0.01

(Ref : S. V. Parthasarathy 1972)

Table 23

**Characteristics of Soils from
Jagaduri (Punjab) Sugar Mill Area**

Parameter	Type I (0-5")	Type II (0-10")	Type III (0-8")	Type IV (0-7")
Clay %	14.1	15.8	7.4	7.6
Silt %	26.5	27.5	8.8	25.7
Sand %	59.4	56.7	83.8	67.2
W H C %	41.3	40.1	26.9	38.2
M. E. %	19.9	18.9	8.07	23.4
pH	7.47	7.70	6.18	9.0
Total Salt %	0.10	0.18	0.02	0.07
Exch. Ca ⁺⁺ m. e. %	6.9	4.8	4.2	2.4
Organic Carbon %	0.44	0.20	0.10	0.37
Total N %	0.083	0.067	0.053	0.061
C/N Ratio	5.3	3.05	1.92	6.10

Ref : S. V. Parthasarathy 1972)

Table 24

Soil Classification according to 7th Approximation

Popular Nomenclature	Equivalent Name in 7th Approx. Dominant Soils
Red Loamy Soil	Paleustalfs Rhodustalfs Haplustalfs
Red Sandy Soil	Haplustalfs Rhodustalfs
Laterite Soil	Plinthaqualts Plinthustults Plinthudults
Red & Yellow Soil	Haplustults Ochraqualts Rhodustults
Shallow Black Soil	Ustorthents Ustropepts
Medium Black Soil	Pellusterts Chromusterts
Deep Black Soil	Pallusterts Chromusterts Palluderts
Coastal Alluvium	Haplaquents
Coastal Sands	Ustipsamments
Deltaic Alluvium	Topaqualfs
Recent Alluvium	Haplaquents Ustifluvents Udifluvents Hoplustalfs
Alluvial Soil-highly Calcareous Old Alluvial Soils	Calciorthents Paleustalfs Haplaquents
Grey Brown Soils	Calciorthids
Terai Soil	Haplaquolls
Brown Hill Soil	Paleliumults
Saline and Alkali Soil	Salorthids Salar-gids Natrar-gids
Peaty	Histosol
Skeletal Soil	Lithic Entisole

[Ref : (i) S. P. Raychaudhari and S. V. Govind Rajan
1971 Review of Soil Res. in India, P. 107-136
(ii) Raychaudhari et al., 1960]

Table 25

**Micronutrient Status of Sugarcane Growing Areas of
Andhra Pradesh**

Nutrient Element (Mean Values for the Dist. in PPM)

Name of District	Zinc	Copper	Iron	Manganese
Nizamabad	0.64	-	--	-
Mepak	0.74	5.2	38.0	21.0
Nalgonda	0.45	5.8	17.0	7.3
Khammam	0.70	5.0	56.0	67.0
Chittor	1.0	-	-	-
Anantpur	0.62	5.2	38.0	170.0
East Godavari	13.1	12.9	193.0	326.0
West Godavari	9.5	9.7	385.0	503.0
Guntur	12.0	9.0	298.0	369.0
Srikakulam	0.95	3.8	54.0	32.0
Nagarjuna Sagar Project	8.9	5.40	368.0	716.0
DTPA Annakapalle	0.96	2.40	23.4	38.6
Extractable NSF Farm				
Belal	1.12	0.75	7.6	5.4
contents in Eklaspur	1.26	0.40	9.0	2.4
soils at				

(Ref : A. R. Micronutrient Schemes APAU 1970-77
Subba Rao & Narsimha 1974)

Table 26

**Canal wise Average Values for Different Fractions of
Manganese in Various Soil Types (Maharashtra)**

Canal	Soil Type	Average Values for Manganese in ppm in		
		Exchangeable	Reducible	Active
Nira Canal	A	1.32	282.4	284.6
	B	1.12	158.4	159.52
	C	3.75	188.0	191.90
	D	1.24	266.0	227.60
	F	1.50	336.0	338.20
	G	1.56	313.0	314.70
Godavari Canal	A	1.82	192.72	195.60
	B	1.58	53.34	55.06
	C	0.95	127.50	128.43
	D	0.85	195.53	196.54
	F	2.66	203.12	205.49
	G	1.46	220.27	221.81
Pravara Canal	A	1.77	241.42	243.24
	B	1.37	78.48	80.56
	C	3.64	139.25	143.14
	D	1.36	153.40	155.04
	G	1.12	276.33	277.47

(Ref : Zende and Pharande, 1958)

Table 27
Micronutrient Content of Sugarcane Soils from
Pune District

Parameter	Range Value	Average Value
Soil pH	6.6 - 9.10	-
% Organic Carbon	0.55 - 2.32	0.93
% CaCO ₃	0.01 - 29.72	6.44
Exchangeable Mn (ppm)	1.0 - 30.0	8.07
Available Iron (ppm)	0.14 - 40.2	6.10
Hot Water Soluble B (PPm)	Tr - 3.11	1.29
Exchangeable Zn (ppm)	Tr. - 38.0	6.54
Available CU (ppm)	0.33 - 4.7	0.56
Available Mc (ppm)	0.02 - 0.65	0.16

(Ref: Shinde et al 1979 J. MPAU 4137 P 239-42)

Table 28
Sulphur Status of Soils in
Different Agroclimatic Zones of Maharashtra State

Location	Shriwardhan	Dapoli	Pune	Akola	Vihad
Av. annual rainfall mm	2527	3365	673	813	1270
Soil pH	5.7	5.1	7.8	8.1	7.4
Organic Carbon %	0.95	1.80	0.57	0.69	0.39
Clay %	36.0	36.6	36.6	49.8	31.5
Soil Classification	Oxisol	Oxisol	Chromu- stert	Chromu- stert	Chromu- stert
Total Sulphur mg/100g soil	28.3	31.5	28.7	31.5	10.8
Organic Sulphur in mg/100 g soil	16.8	24.2	15.0	15.0	5.4
Water Soluble 504-S mg/100 g	1.6	1.3	3.6	4.4	1.3
Water in Soluble in organic S mg/100 g	10.3	6.0	10.1	12.1	4.0

[Ref: Tanawade et al 1976 J. M. A. U. 1(1)]

Table 29

Available and Exchangeable Manganese in Sugarcane Soils from Different States (A. P. & Maharashtra)

Location Parent Mat.	Soil depth in cm	Soil pH	% Org. Carbons	% Clay	Textural Class	Available Mn - Zn NH ₄ H ₂ PO ₄	Exch. Mn ⁺⁺ N NH ₄ Ac in ppm	Aspergillus Method	A N NH ₄ H ₂ PO ₄
Anakapalle (A. P.) Coastal Alluvium	0-15	7.2	0.45	18.9	S. L.	66.0	35.6	-	-
	15-30	7.2	0.37	21.3		46.0	21.6		
	30-45	7.3	0.39	20.6		40.0	14.4		
Tanuku (A. P.) Alluvium	0-15	7.2	0.70	40.7	Clay	51.6	13.1	-	-
	15-30	7.2	0.45	44.7		23.0	4.1		
	30-60	7.8	0.28	45.3		13.5	1.6		
Anakapalle (A. P.) Coastal Alluvium	0-15	7.2	0.51	28.6	C. L.	34.0	11.9	2.7	12.1
	15-30	7.5	0.37	27.8		26.0	6.3	2.8	9.1
	30-43	7.3	0.35	32.6		29.0	8.1	10.0	2.9
Rudrur (A. P.) Gneissic Complex	0-15	7.6	0.41	17.6	S. L.	26.0	12.8	-	-
	15-30	7.2	0.42	23.6		20.5	6.3		
	30-45	7.7	0.35	29.9		13.0	1.9		
Padegaon (M. S.) Deccan Trap	0-15	7.9	0.81	46.0	Clay	21.0	3.1	7.5	0.9
	15-30	8.5	0.65	48.0	(Black)	17.0	1.3	20.0	1.1
	30-45	8.8	0.41	43.8		16.0	1.6	15.0	0.8
Vuyur (A. P.) Alluvium	0-15	8.2	0.65	42.4	Clay	23.0	0.9	20.0	1.1
	15-30	8.3	0.44	40.8	(Black)	21.5	1.6	20.0	1.1
	30-45	8.4	0.39	42.0		8.0	1.9	10.0	0.8

(Ref: Anjaneyulu, 1964)

Table 30

Available Micronutrient Contents of Gujarat Soils

Soil Type	Available				
	Copper	Molybdenum	Boron	Zinc	Cobalt
	Values in ppm				
Sandy	0.4	0.06	0.6	2.2	0.5
Sandy Loam	0.5	0.09	0.7	2.9	0.3
Silt Loam	0.5	0.11	0.6	1.9	0.4
Clay Loam	0.9	0.09	0.8	3.0	0.2
Sandy Clay	0.5	0.09	0.4	2.3	0.3
Clayey	0.6	0.09	0.7	3.0	0.7

(Ref: Mehta et al 1964)

Table 31

Iron & Manganese Contents of Sugarcane Soils of Bihar

Constituents	North Bihar		South Bihar	
	Calcareous Soil	Non Calc Soil	Sone Alluvium	Heavy Clay
Soil pH	8.7	8.3	7.3	7.5
CaCO ₃ %	27.3	2.4	2.3	2.90
Total Fe %	2.0	2.28	2.72	3.34
Total Manganese in ppm	335	433	566	857
Exch. Mn (ppm)	17.7	5.6	3.4	4.0
Water Soluble Mn	0.24	0.26	0.53	0.60
Reducible Mn	55.0	90.0	214.0	368.0
Active Mn	72.9	95.8	217.6	372.0
Ratio Active/Total	0.22	0.25	0.40	0.42

(Ref: K. K. Jha 1964)

Table 32

Profile Distribution of Mn in Alluvium Soil Division of Bihar

Soil Type	Depth	pH	Manganese (in ppm)				Total
			Water Soluble	Exch.	Reducible	Active	
Sandy	0-15	6.1	0.42	8.0	32.0	40.92	280
	15-50	6.9	0.58	2.9	52.6	55.28	350
	50-75	6.9	0.20	2.3	60.8	63.3	400
Sandy Loam	0-15	6.3	0.46	18.20	156.2	174.9	830
	15-43	6.7	0.53	18.10	162.5	178.1	800
	43-125	6.9	1.40	11.0	225.0	237.4	1060
Sandy Clay Loam	0-30	6.5	1.0	38.8	173.0	213.5	980
	30-55	6.5	1.60	35.0	182.5	259.1	930
	55-160	6.5	0.5	20.0	182.5	203.0	960

(Ref: Khanna et al 1957)

Retentivity and Availability of Soil Moisture in the Profile from Different Agro-climatic Zones of M. S.

Location	Zone	Soil Depth	% Clay	Bulk Density gm/cm ³	Total Porosity	Moisture Retained at 1/3 bar	Moisture Retained at 15 bar	Available Water %	mm	in the Profile
Chandgad (Kolhapur)	High Rain Fall	0-15 30-55	31.2 29.8	1.31 1.41	49.8 46.0	30.7 25.2	18.1 17.8	12.6 7.4	24.7 25.9	69.33
Mahabaleshwar (Satara)	Ghat Zone	0-15 30-54	37.2 30.7	1.27 1.35	51.1 51.3	31.5 25.9	18.4 18.0	13.1 7.9	24.9 25.5	71.0
Vadgaon (Pune)	Transition I	0-15 30-60	50.1 51.5	1.20 1.27	54.7 54.3	36.8 36.8	19.3 19.6	17.5 17.2	31.6 64.4	193.0
Kolhapur	"	0-15 30-60	46.6 49.7	1.27 1.30	52.6 54.3	34.9 34.4	21.6 21.9	13.3 12.5	25.1 41.1	144.3
Pune	Transition II	0-15 30-60	45.5 52.0	1.14 1.18	56.3 55.1	42.1 42.4	21.9 21.5	20.2 20.9	34.5 74.3	264.0
Mangalvedha (Solapur)	"	0-15 60-90	64.2 64.2	0.88 1.07	62.3 59.6	44.3 44.0	23.0 22.2	21.3 21.8	31.0 70.0	349.0
Rahuri (Ahmednagar)	Scarcity Zone	0-15 60-90	45.2 50.0	1.07 1.08	59.4 59.2	40.1 42.8	22.5 21.0	17.6 20.9	28.0 67.6	319.7
Solapur	Scarcity Zone	0-15 30-60	64.2 58.7	0.88 1.06	62.6 61.3	42.7 39.6	21.7 20.2	21.0 19.6	31.2 62.4	124.6

(Ref: Mungare et al 1983, J. Mah. Agri. Uni. 8(1) P. 9-13)

Table 34

Phosphate Fixation and P Availability in Different Soil Types

Soil Type	Free CaCO ₃ %	% PO ₄ fixation at		Available P ₂ O ₅ after fixation		in Soil in Mg/100g After destroying CaCO ₃ in Soil	
		125 kg of added phosphate per acre	500 kg	125 kg P ₂ O ₅	500 kg P ₂ O ₅	125 kg P ₂ O ₅	500 kg P ₂ O ₅
A	5.01	93.52	69.30	17.44	42.0	35.9	66.7
B	10.14	93.20	77.56	7.62	17.75	24.14	57.7
C	8.76	95.84	79.72	4.68	11.66	42.23	53.6
F	5.05	85.44	56.72	22.59	35.88	36.0	50.0
G	6.92	87.60	69.46	20.49	34.26	46.6	51.5

(Ref: Raghavan and Patel. 1952 - D. S. T. A. 9th Conven. P. 63)

Table 35
K Fixation Capacity of Some Indian Soils

Location	Belgaum	Coimbatore	Padegaon	Hyderabad	Nagpur	Karjat	Pusa
(a) % K fixation capacity	0.99	25.5	12.31	9.12	18.75	12.35	26.8
(b) Soil pH	6.3	8.6	9.0	8.6	7.9	6.5	8.1
		<u>Karnal</u>	<u>Burdwan</u>	<u>Assam</u>			
	(a)	23.7	18.35	52.54			
	(b)	8.1	5.8	6.4			
(Ref: Roy et al. 1978 Fert. News 23(6) P. 3-26)							
Location	Nandgaon	Dapoli	Manjri	Dhule	Digranj	Solapur	Parbhani
(c) Level of K added	- - - - -	- - - - -	- - - - -	mg of K ₂ O fixed per 100 gm Soil	- - - - -	- - - - -	- - - - -
(d) 1 me/100 g	11.3	13.1	18.7	13.6	21.6	21.0	25.5
(e) 4 me/100 g	46.8	29.4	50.7	48.9	51.6	54.8	52.6
	<u>Akola</u>	<u>Nanded</u>					
(d)	19.2	19.6					
(e)	49.2	51.6					
(Ref: Talele & Zende, 1981)							

Table 36

K Characteristics of Different Soil Orders

Soil Order	Alfisol I	Vertisol II	Vertisol II	Aridisol I	Aridisol II
Location	Mandya	Sankeshwar	Gangavati	Pusa	Lucknow
Texture	Sandy Loam	Black Clay	Black Clay	Loam	Sandy Loam
CEM m.e. %	11.96	77.22	61.78	9.85	11.72
(1), Exch. K in conc H ₂ SO ₄ (m.e. %)	0.31	0.68	0.68	0.18	0.55
(2) Exch. K in 1 N Am. Acetate (m.e. %)	0.333	1.026	0.974	0.320	0.487
(3) K Saturation %	2.79	1.33	1.58	3.25	4.16
(4) Isotopically Exch. K (m.e. %)	1.74	0.21	0.24	0.69	2.45
Dominant clay mineral in clay fraction	Kaolinite	Smectite	Mont- morillonite	Mica- illite	Illite
Δ GK (Cal/mole) (Chemical Potential)	- 3740	- 3920	- 3400	- 3200	- 3280

(Ref : G. Hunsigi and S. C. Srivastava 1986
D. S. T. A. 30th Convention 63-72)

Table 37

Availability Index of Soil K

Location	State	Soil pH	Fraction of K in Soil (Kg/ha) extractable in		
			N NH ₄ O AC	Boiling HNO ₃	Diluted H ₂ SO ₄
Cuddalore	Tamil Nadu	7.0	40	50	40
Coimbatore	Tamil Nadu	6.8	212	480	215
Dimapur	Nagaland	6.7	50	140	55
Kanska	West Bengal	7.0	60	80	63
Lucknow	Uttar Pradesh	7.0	112	260	115
Lauriya	Bihar	7.5	30	60	30
Mandya	Karnataka	7.3	100	160	100
Mangalore	Karnataka	6.4	50	100	60
Ratnagiri	Maharashtra	6.9	120	160	130
Tiruvella	Kerala	7.0	113	220	120

(Ref : S. M. H. Jafri, 1983)

Table 38

Effect of Deep Ploughing on Cane Yield
and Juice Quality of Sugarcane (Co 419)

Operation	Cane Yield T/ha	% Juice Sucrose
Deep Ploughing	91.97	17.52
Normal Ploughing	75.67	16.83

Table 39

Effect of Chi selling on Sugar Cane Yield (t/ha)

	Nizamabad	Rudrur
Desihal	98.8	110.2
Chiselling	102.4	123.8
Chiselling + Gypsum 5 T/ha	110.7	136.2
Chiselling + FYM 25 T/ha	129.6	138.8
C D at 5%	6.6	17.8

(Ref: M. Suryanarayan Reddy, Bharatiya Sugar, April 1986)

Table 40

Effect of Taking More Ratoons on Physical Parameters of Soil

Depth of Soil	Average Bulk Density in gm/cm ³ (Variety CO 1148)			
	1st Ratoon	2nd Ratoon	3rd Ratoon	7th Ratoon
0 - 15 cm	1.48	1.59	1.61	1.48
16 - 30 cm	1.57	1.62	1.63	1.54
31 - 45 cm	1.63	1.65	1.73	1.56
46 - 60 cm	1.67	1.67	1.76	1.67
% Pore Space Distribution at Different Depths				
0 - 15 cm	43.8	40.0	39.2	43.8
16 - 30 cm	40.0	38.8	38.5	41.9
31 - 45 cm	38.5	37.7	34.7	41.1
46 - 60 cm	37.0	37.0	33.6	39.2

(Ref: Srivastava S. C. 1981, Maharashtra Sugar 6(8) P. 37-38)

Table 41

Effect of Cropping System on Physical Characteristics of a Soil

Treatment	Bulk Density gm/cm ³	% Max. Water holding Capacity	Pore Space %	Volume Expansion of Soil %
1. Manjri Method of Cultivation	1.16	71.1	51.5	62.6
2. Plant Cane Unmanured	1.12	68.1	51.6	42.2
3. Plant Cane Manured	1.19	71.1	58.2	41.5
4. Adsali 18 months Manured	1.19	72.0	60.8	42.4
5. Adsali 22 months Manured	1.17	77.2	56.8	60.5
6. Adsali 22 months Unmanured	1.24	65.7	55.4	51.6
7. Ratoon Unmanured	1.22	71.7	60.0	49.4
8. Ratoon Manured	1.16	69.7	61.5	40.2
9. Fallow, Cultivated Irrigated, Manured	1.15	75.6	58.7	58.6
10. Fallow, Cultivated Irrigated	1.18	78.3	61.7	50.8
11. Fallow, Cultivated, Unirrigated	1.36	72.3	60.1	50.6
12. Fallow, Uncultivated Irrigated	1.11	75.4	59.6	49.9
13. Complete Fallow	1.14	71.4	60.3	46.7

(Ref: Hapse, 1978)

Table 42

Performance of Different Plantings on Major Soil Types of D. C. A.
(Cane Yield in M/T/Acre)

Location Soil Type	Kopargaon A			Padegaon B			Akluj D			Lakhmapur F			Deolali G		
Months of Planting	July	Oct.	Jan.	July	Oct.	Jan.	July	Oct.	Jan.	July	Oct.	Jan.	July	Oct.	Jan.
Year 1941-44	49.1	45.0	43.7	47.6	41.7	38.3	44.3	44.8	39.2	32.3	28.6	30.2	49.0	38.0	37.0
Year 1948-59	62.0	48.4	44.2	57.6	47.7	42.8	54.4	37.4	37.4	50.4	38.5	26.7	54.0	48.0	36.0

1956-58

Variety :

(a) CO 678	63.25		75.9		90.0		49.2		56.7
(b) Co 419	52.90		53.0		76.6		35.3		58.5
(c) CO 740	65.50		74.6		90.9		43.2		58.8
(d) CO 775	48.10		63.0		73.9		38.3		55.5
(e) CO 798	63.50		71.6		85.8		51.3		71.8
Av.	58.65		67.6		83.4		43.5		60.2
			CCS Acre						
(a)			9.86						
(b)			7.70						
(c)			11.00						
(d)			9.3						
(e)			9.6						

(Ref : Zende, 1970)

Table 43

**Effectiveness of Gypsum and Dhaincha
in the Reclamation of a Saline- Alkali Soil**

Soil Character	Initial Value	Soil Analysis at the end of one year		Soil Analysis at the end of second year	
		Gypsum alone	Gypsum + Dhaincha ¹	Gypsum alone	Gypsum + Dhaincha
Soil pH	10.2	8.7	8.6	8.6	8.5
<u>Saturation Extract</u>					
Ec x 10 ³	18.99	3.57	1.75	1.65	1.42
CO ₃ m.e. %	0.6	0.07	0.03	Tr.	Tr.
HCO ₃ m.e. %	2.39	0.81	0.66	0.80	0.71
Cl m.e. %	3.97	0.17	0.11	0.06	0.03
SO ₄ m.e. %	2.85	0.77	Tr.	Tr.	Tr.
Total anions m.e. %	9.81	1.85	0.80	0.86	0.74
C. E. C. m.e. %	8.4	7.44	7.64	7.44	7.84
Exch Na m.e. %	4.36	0.40	0.34	0.36	0.33
Exch K m.e. %	0.12	0.12	0.06	0.12	0.11
% Exch Na	51.9	5.38	4.45	4.84	4.21
Total N %	0.04	0.06	0.06	0.05	0.09
Org. Carbon %	0.25	0.33	0.34	0.36	0.53
C/N Ratio	6.25	5.50	5.67	7.20	5.89
Permeability in/hr.	0.02	0.83	1.02	1.07	1.68

(Ref : J. S. P. Yadav and R. R. Agarwal, 1961.

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Table 44

Percent Improvement in Salinity by Waste Products

Treatments	G. Nut Hulls	Saff Hulls	Paddy Husk	Molasses	Press Mud Cake	Saw Dust	Tamrind Seed Powder
% improvements in Salinity	48.76	51.24	30.87	37.0	18.52	37.65	61.1

(Ref : Zende, 1968. Res. Bull, 13)

Table 45
Effect of Balanced Fertilization on Crop Performance

Location	Shahjahanpur	Ranjeetgunj	Gurgutta	Betishadev
Available N in Kg/ha.	94.43	98.60	105.8	118.2
Available P ₂ O ₅ in Kg/ha.	19.12	4.34	20.11	9.86
Available K ₂ O in Kg/ha.	84.0	75.6	84.0	75.6
Organic Carbon %	0.14	0.29	0.24	0.49
Soil pH	7.0	8.0	7.6	7.5
Texture of Soil	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
Treatment	No. of Millable Canes per Ha.			
N ₁	110809	78840	62238	67460
N ₃	113748	79640	58905	63194
Fert. applied on Soil Test Basis	119876	83140	62238	70859
	Cane Yield in M. T./Ha.			
N ₁	78.3	64.4	39.5	63.3
N ₃	92.9	64.4	38.3	58.2
Fert. applied on Soil Test Basis	98.2	75.3	45.3	65.9

(Ref : Srivastava and Shukla, 1986. Mah. Sugar 11(11) P. 67)

Table 46
Changes in Soil Properties and Percent Releases of N
in a Soil Treated with Different Manures & Fertilizers

Treatment	FYM	Sann hemp (GM)	Safflower Cake	Sulphate of Ammonia	Manjari Method of Cultivation
% Organic Carbon	0.92	0.89	0.72	0.67	0.77
% Total Nitrogen	0.048	0.059	0.069	0.087	0.041
C/N Ratio	19.2	14.9	10.3	7.7	16.8
Total N in mg/100 g soil extracted in					
10 extracts	12.93	9.39	8.79	10.72	9.81
% of N Released	26.95	16.8	12.66	12.32	23.9
					Con
Soil pH	8.2		8.2	7.7	8.4
Humus %	1.09		0.91	0.73	1.1
P ₂ O ₅ in mg/100 g soil	19.1		14.3	9.76	5.1
K ₂ O in mg/100 g soil	71.8		37.4	51.8	43.7

(Ref : Mirajkar et al. 1956 Proc. D.S.T. A. 13th Conven. P. 48-54)

Table 47-A
Effect of Continuous application of FYM on the Enrichment of Soil Up to a Depth of Three Feet

Soil Parameter	Percent Increase over irrigated control	Over dry Control
% Total Nitrogen	42.0	46.8
% Organic Carbon	25.0	29.8
% Total P ₂ O ₅	22.7	27.8
% Total K ₂ O	5.93	29.5
Available P ₂ O ₅	54.2	57.7
Available K ₂ O	67.4	76.5

(Ref: Basu and Kibe, 1946, Current Sci. 15, P. 131-132)

Table 47-B
Residual Effect of adding Different Sources of Org. Materials on Soil Properties (Clay Loam Soil)

Parameter	Control	Paper Sludge	F. Y. M.	Saw Dust	Rice Husk	G. Nut Shell	Wheat Straw	Rice Straw
% Increase in infiltration rate	-	10.7	34.5	40.7	118.4	81.5	82.0	133.0
% Increase in W. H. C.	-	8.4	8.8	4.8	9.8	10.1	16.2	10.1
% Increase in Hydraulic Conductivity	-	66.6	55.5	44.4	111.1	85.5	88.3	111.1
% Increase in Org. Carbon	-	13.7	15.7	13.7	21.5	16.7	13.7	21.5
% Increase in Aggregate Stability	-	41.3	15.0	4.0	8.0	17.3	33.9	42.2
% Increase in W. S. A.	-	12.6	2.9	2.4	20.0	7.0	8.0	27.3

(Ref: Lavti and Paliwal, 1981)

Table 48

Changes in Soil Fertility During a Period of 25 Years

Soil Attribute	Year	No Compost (Average effect of 6 Combination)	Compost
Soil pH	1943	8.47	8.44
	1969	7.86	7.73
Organic Carbon %	1943	0.84	0.80
	1969	0.82	0.80
Total N %	1943	0.043	0.045
	1969	0.064	0.055
C/N Ratio	1943	20.5	18.4
	1969	12.9	15.2
Exch. Ca ⁺⁺ m.e. %	1964	46.9	46.3
Exch. Mg ⁺⁺ m.e. %	1964	14.04	14.5
P ₂ O ₅ in mg/100 g soil	1943	12.7	11.1
	1969	18.7	16.9
K ₂ O in mg/100 g soil	1969	33.4	34.0
Water Dispersion Coff.	1964	42.0	38.5
Sticky Point Moisture %	1964	32.1	32.1
Water Stable Aggregates	0.5 mm	4.69	7.15
	0.25 mm	27.73	44.40

(Ref: P. M. Joshi and G. K. Zende 1971, Proc. 14th Cong. I. S. S. C. T.
P.612 - 20)

Table 49

Effect of System of Sugarcane Cultivation on Changes in Chemical Fertility of Soil

Soil Parameter	Period	Plant Cane		Adsali Cane		Ratoon	
		Unmanured	Manured	Unmanured	Manured	Unmanured	Manured
Soil pH	1952	8.24	8.24	8.21	8.24	8.24	8.24
	1963	7.73	7.65	7.79	7.85	7.82	7.75
% Organic Carbon	1952	0.64	1.05	0.79	1.05	0.73	0.89
	1963	0.76	1.01	0.90	1.17	0.91	1.12
% Total Nitrogen	1952	0.046	0.074	0.052	0.07	0.058	0.063
	1963	0.04	0.082	0.056	0.085	0.049	0.086
Exch. Ca ⁺⁺ m.e. %	1952	42.0	42.5	43.75	43.25	43.75	46.25
	1963	41.0	39.1	-	-	49.0	49.5
Water Dispersion Coefficient	1952	45.4	46.9	55.0	46.8	49.0	44.9
	1963	29.5	29.6	32.8	35.4	31.2	30.0
Water Stable Aggregates ≥0.25 mm.	1952	74.9	69.0	49.9	69.9	71.5	72.3
	1963	54.0	63.0	60.6	60.3	64.1	68.8

(Ref: Bawaskar V. S. and Zende G. K., 1973)

Table 50

Effect of Level of Soil Fertility on Cane Yield

Soil Fertility Level	L ₀	L _{1/2}	L ₁	L ₂
Available N in soil Kg/ha before planting of Cane	208	251	327	401
Available P ₂ O ₅ in soil in Kg/ha before planting	23.8	28.0	40.0	52.0
Available K ₂ O in soil in Kg/ha before planting	613	638	657	694
Maximum cane yield in NPK treated plots MT/ha	113.0	143.0	153.0	162.0
Fertilizer applied N	450	350	350	350
P ₂ O ₅ & K ₂ O	170	170	120	120
Lowest cane yield in NPK treated plants MT/ha	57	82	84	91
Fertilizer applied N	0	0	0	0
P ₂ O ₅ & K ₂ O	120	120	120	120
Maximum Cane Yield under Control Treatment MT/ha	50	63	55	72
Lowest Cane Yield in Control Treatment MT/ha	36	45	44	50

(Ref: Zende G. K. and D. B. Bharavase, 1981, DSTA 31st Convention)

Table 51

Limits of Sufficiency and Deficiency Based on Availability Indexes of N P and K in Soil and Plant
(Varieties Co 1158 and CO 1148)

Soil Limits	Plant Limits (%) in			
	CO 1158		CO 1148	
	Plant	Ratoon	Plant	Ratoon
1. <u>Alkaline hydrolyseable N</u>				
400 kg/ha (high)	> 1.517	> 1.732	> 2.012	> 2.283
200 kg/ha (low)	< 1.212	< 1.541	< 1.143	< 1.495
2. <u>NO₃-N</u>				
51 kg/ha (high)	> 1.518	-	-	-
19 kg/ha (low)	< 1.336	-	-	-
3. <u>Olsen's P</u>				
50 kg/ha (high)	> 0.119	> 0.106	> 0.157	> 0.090
25 kg/ha (low)	< 0.090	< 0.088	< 0.100	< 0.061
4. <u>Exchangeable K</u>				
250 kg/ha (high)	> 1.78	> 2.032	> 2.58	> 3.05
100 kg/ha (low)	< 1.42	< 1.92	< 2.30	< 2.50

(Ref: S. M. H. Jafri, 47th Conven. STAI, 1983 P. 149-156)

- Note :**
1. Availability index of Soil N in alkaline permanganate and NO₃-N were found to be positively correlated with total N in 3-6 sugarcane leaf blades during formative stage (i.e. 60-120 days age of crop) ($r = 0.82$ and 0.715 respectively)
 2. Olsen's P was found positively correlated with total P in 3-6 leaf sheath at formative stage of crop.
 3. The exchangeable K⁺ was found positively correlated with total K in 3-6 leaf sheath.

Table 52

Correlation Between Soil Parameters, Nutrient Index and Cane Yield

Particulars	Coefficient of Correlation	
(i) Level of $\text{NO}_3\text{-N}$ in Soil in November x Cane Yield (Adsali)	0.406 ^{xx}	
(ii) Level of $\text{NO}_3\text{-N}$ in June x Cane Yield (Adsali)	0.243 ^x	
(iii) Available N in Soil (kg/ha) x % N in whole Plant at 5 months	0.81 to	0.87 ^{xx}
(iv) Available P_2O_5 in soil (kg/ha) x % P in plants at harvest	0.84 to	0.93 ^{xx}
(v) Available K_2O in soil (kg/ha) x % K in plants at harvest	0.58 to	0.80 ^{xx}
	<u>Adsali</u>	<u>Ratoon</u>
(vi) Soil Fe (ppm) x cane yield	0.38 ^x	0.37 ^x
(vii) Soil Mn (ppm) x cane yield	0.14 ^x	0.38 ^x
(viii) Soil Zn (ppm) x cane yield	0.13 ^x	0.58 ^{xx}
(iv) Org. Carbon % in soil x cane yield	0.39 ^x	0.29
(x) Av. P_2O_5 in soil (kg/ha) x Cane yield	0.31	0.38 ^x

(Ref: Zende, 1974 and 1983, Patil and Zende, 1980,
Zende and Bhanavase, 1981)

Table 53

Correlation Coefficient Between Tissue Indices
(Age 10 to 12 months) and Yield of Cane with
Electrical Conductivity of Soil

Variables	Correlation Coefficient in Adsali Cane	Correlation Coefficient in Ratoon Crop
EC x 10^3 mm hos / cm x sheath moisture %	- 0.08	- 0.51 ^{xx}
EC x Nitrogen (%)	- 0.15	- 0.60 ^{xx}
EC x Phosphorus (%)	- 0.09	- 0.29
EC x Potassium (%)	- 0.17	- 0.32
EC x Manganese (ppm)	- 0.44 ^{xx}	- 0.22
EC x Iron (ppm)	- 0.39 ^{xx}	- 0.32
EC x Zinc (ppm)	- 0.21	- 0.56 ^{xx}
EC x Yield (tons/ha)	- 0.66 ^{xx}	- 0.66 ^{xx}

(Ref: Patil et al. 1983, Patil and Zende,
D.S.T.A. 33rd Convention, P. 121) 1983 Mah. Sugar Feb. P. 33)

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SUGAR INDUSTRY IN MAURITIUS

H.C. SOOD

(Mr. H. C. Sood was deputed as Sugar Expert to the Government of Mauritius by the Ministry of External Affairs, Government of India under the Indian Technical Cooperation Programme from the year 1983 to 1985. He assisted the Sugar Inquiry Commission on the Sugar Technical aspects. This article is an outcome of his studies, observations and survey of the Mauritius Sugar Industry. It is hoped that the information and data given therein will be of great use to all concerned with the development of Indian Sugar Industry. The readers are most welcome to contact Mr. H. C. Sood or the Editor, Bharatiya Sugar for any further information required by them regarding Sugar Industry in Mauritius - Editor)

1. General & Historical

History of Mauritius is closely associated with the Sugar Industry, which till today remains the backbone of the Island's economy. 'Pear-shaped' or 'Heart-shaped' depending upon whether you look at it from the Northern or Southern Hemisphere, the island of Mauritius together with Reunion and Rodrigues forms part of the Mascarene Archipelago in the South Indian Ocean. The island of scenic beauty covers an area of 720 square miles and is situated near the intersection of latitude 20° South and longitude 57° East. It lies about 550 miles east of Madagascar, 1250 miles off coast of Africa and about 2560 miles off from Bombay. Map of Mauritius is provided here (Map No. 1)

There is historical evidence that the island was known to the early Arab navigators, but in the year 1528 it was first discovered by the Portuguese who, however, did not settle down in this island. Later in 1598 the Dutch took possession and named this island as 'Mauris'. Although they occupied island for more than 100 years, yet they were unsuccessful in rehabilitating this island and they left in 1710. In the year 1715 French came to occupy this island and named it 'Isle de France'. During Napoleonic wars Britain took possession of the island in 1810, and renamed this as 'Mauritius'. Mauritius remained under British rule till 1968, when it became independent.

1.2 Story of Sugar

The story of Sugar in Mauritius dates back to 1639, when the Dutch Governor Van der Stel introduced Sugarcane from Batavia. Sugarcane was developed chiefly for the production of country liquor known as "Arrak", although records are available that sugar was first made in the island in the year 1696.



OLD HAND DRIVEN CANE MILL

Under the administration of the French Governor, Mah'e de la Bourdonnais the production of Sugar was developed and by 1755 the production was sufficient enough to meet the local consumption and neighbouring island Bourbon (now Reunion). Within fifty years sugarcane cultivation developed to cover 4000 hectares and about 3000 tonnes of sugar was produced by 60 mills. With rehabilitation of the island need was felt to grow food crops, consequently the sugarcane area was reduced to one fourth. Moreover there was shortage of labour, which was mainly the African slave labour.

The sugarcane cultivation again picked up fast under the British rule. The first British Governor Sir Robert Farquhar, realising the economic importance of Sugar Industry, gave new impetus to this industry. Sugarcane cultivation being labour intensive, the Sugar Industry was menaced and the British rulers thought of importing cheap Indian labour. Indian

immigration under the indenture system was introduced from 1834. From 1850 onwards the immigration went on "En Masse" and four and a half lakh of Indians were taken to Mauritius till 1923. Indentured Labour had to work very hard under very difficult and adverse circumstances, and poor working and living conditions. It is their hard work and personal sacrifices which have been responsible for development and reclamation of the land for sugarcane cultivation and consequently the economic growth of the country.

The development progressed at a steady pace and in 1858 there were 259 sugar factories, the highest number ever in the island and cane lands covered over 46,430 hectares. Abolition of the special import duty on Mauritius sugar entering United Kingdom gave an impetus and by 1860 Mauritius produced 1,30,000 tonnes of Sugar. During the next thirty years the Sugar Industry was almost stagnant and suffered many ups and downs viz, outbreak of malaria, drought, cyclones, pest and diseases, competition with beet sugar etc. The number of Sugar Factories came down to 124 in 1891. These setbacks induced planters and millers both to improve sugarcane cultural practices viz; introduction of new resistant varieties, use of chemical fertilizers, as also better manufacturing control.

With economic and technical progress there was further centralisation. The number of factories fell down to 85, and then to 23 around 1960. Since 1970 only 21 factories are in operation. By virtue of improvements both in field and factory there was record production of 718,000 tonnes of Sugar in the year 1973 in twenty one sugar factories.

From the primitive animal driven cane Mills way back in early sixties there came the vertical cylinders, and then the horizontal cylinders and the use of steam power around the year 1820, and then the proper vacuum pan sugar factories, which were progressively modernised.

2. Topography, Climate & Soils

Mauritius is entirely of volcanic origin and is fringed by coral reefs. The attitude varies between 900 ft. and 2400 ft. The climate also is thus varying and is tropical during summer and sub-tropical during winter. The South East winds prevail for the greater part of the year but are steadier from May to October.

The mountain ridges have a considerable influence on rainfall. On the central plateau the heaviest annual precipitations may reach up to 200 inches in some localities. The rainfall varies considerably from year to year. The island suffers from the influence of tropical cyclones, which occasionally cause severe damage. Age long experience in

sugarcane cultivation has shown that the sugarcane plantation is the best adopted to recover from the effect of cyclonic winds.

The soils were formed by the decomposition of late lavas and their distribution is closely related to rainfall and the age of the parent rock. Zonal and intrazonal soils make up most of the agricultural lands, the Zonal soils being free (Latosols) whereas the intrazonal soils (Latosolic) are mainly gravelly. The fertility of soils in the sub-humid region is governed by the availability of water. The gravelly soils have a lower capacity for water retention and the leaching of nutrients is more substantial than in the free soils.

The Table No. 1 (a) and Table No. 1 (b) show the monthly rainfall for the years 1979-83 average over whole sugarcane area and mean maximum and minimum air temperature for the same period. The Map No. 2 shows annual rainfall.

3. Cane Cultivation

3.1 Categories of Planters

(2.37 Arpents = 1 Hectare = 2.47 Acres)

There are four categories of producers in Mauritius viz. :

(a) Miller Planters :

They own both sugar factories and sugarcane Plantation range from 1100 to 12,600 arpents.

(b) Large Planters :

They cultivate sugarcane 100 to 2000 arpents.

(c) Small Planters :

Usually the planters who cultivate sugarcane less than 100 arpents are termed as small planters. Such planters are further divided into four sub-categories as under :

- (i) - those cultivating 0.01 to 0.99 Arpents
- (ii) - those cultivating 1.0 to 4.99 Arpents
- (iii) - those cultivating 5.0 to 19.99 Arpents
- (iv) - those cultivating 20 to 99.9 Arpents.

(d) Tenant Planters :

They are also small planters, growing sugarcane less than 5 Arpents.

3.1.1 Category wise Yields

The Table No. 2 gives the distribution of various categories of planters alongwith their numbers, areas under sugarcane, Tonnage and Tonnes cane/arpent for the 1981.

It will be observed that :

- (i) Highest proportion (51.6%) of the planters own only less than one arpent, while 92.6% own less than 5 arpents. Only 6.8% of the planters own land between 5 arpents and 20 arpents.

MAURITIUS



PHOTOGRAPH NO 3



The sugar cane variety M 3035/66

Table 1 (a)

Table showing Monthly Rainfall (mm) 1979-1983
(average over whole sugar cane area)

CROP YEAR	GROWTH PERIOD (deficient months in italic characters)								MATURATION PERIOD (excess months in italic characters)			
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Normals 1931-1980	100	190	275	297	314	237	158	132	125	103	76	66
Extremes	13	44	68	66	85	37	41	25	41	15	18	9
To date	335	1138	825	915	990	701	544	419	260	318	205	250
1979	104	64	332	312	256	173	165	117	70	156	42	46
1980	60	594	996	198	529	335	132	94	121	63	88	87
1981	58	85	162	106	301	437	78	50	121	81	71	71
1982	152	180	219	788	153	228	354	107	196	186	145	166
1983	156	227	292	182	56	108	101	59	94	46	42	65

Table 1 (b)

Table showing Monthly Air Temperature (°C) 1979-1983
(Mean maximum & minimum recorded at Plaisance airport)

YEAR	Nov.		Dec.		Jan.		Feb.		Mar.		Apr.		May		June		July		Aug.		Sep.		Oct.	
	M	m	M	m	M	m	M	m	M	m	M	m	M	m	M	m	M	m	M	m	M	m	M	m
Normals 1961-1980	27.6	20.1	29.0	21.7	29.3	22.5	29.3	22.7	28.9	22.5	28.1	21.3	26.5	19.7	25.1	18.3	24.1	17.8	23.7	17.5	24.6	17.7	25.9	18.7
1979	28.1	20.8	29.4	22.2	29.6	22.9	28.6	23.5	28.6	22.5	27.8	21.1	26.6	20.3	25.2	19.0	24.1	18.2	24.4	18.2	25.6	19.0	26.6	18.9
1980	28.5	20.9	29.6	22.7	28.9	23.3	28.7	22.6	29.4	23.4	28.4	22.0	26.7	20.5	25.5	19.4	24.3	18.5	23.8	17.7	24.8	18.5	26.3	19.2
1981	27.6	20.9	29.3	22.2	30.5	23.3	30.3	23.2	29.8	22.7	28.4	22.8	26.9	20.1	25.7	18.4	24.0	17.3	24.4	17.4	24.8	18.5	26.8	19.6
1982	27.8	19.9	28.5	21.7	29.6	22.9	28.9	23.2	29.2	22.5	28.3	21.3	26.0	20.2	24.4	19.4	23.8	18.2	23.5	17.6	24.6	18.9	25.2	19.4
1983	27.3	21.3	28.1	21.6	28.8	22.5	29.8	23.8	29.7	22.7	28.9	21.8	27.0	20.2	25.6	19.5	24.9	18.3	24.5	17.3	24.9	17.3	26.1	18.8

Table 2
Showing Category-wise Cane Yield per Arpent

Sr. No.	Category (Arpents)	No.	Area Arpents	Tonnage	T.C.A.	Yield Gap
1.	0.01 - 0.99	17494 (51.6%)	7724	192,882	25.0	7.7
2.	1.00 - 4.99	13871 (41.0%)	29956	706,635	23.6	9.1
3.	5.00 - 19.99	2294 (6.8%)	18482	406,371	22.0	10.7
4.	20.00 - 99.99	218 (0.6%)	8604	205,967	23.9	8.8
	Total Small Planters	33877				
5.	100.00 + 200.00	45	13589	339,699	25.0	7.7
6.	Miller-Planters	-	105,502	3,449,915	32.7	-
	Total Planters	-	183,857	5,301,469	28.8	-

Table 3
Yearly Yield of Sugarcane per Arpent of the Different Categories of Planters

Sr. No.	Category of Planters (Arpents)	1973	1974	1976	1977	1978	1979	1980	1981
1.	0.01 to 0.99	27.1	24.8	29.5	27.9	29.9	30.0	22.4	25.0
2.	1.00 to 4.99	26.9	24.3	28.8	27.3	29.2	29.2	21.1	23.6
3.	5.00 to 19.99	26.6	23.9	27.4	25.2	26.9	27.3	20.1	22.00
4.	20.00 to 99.99	29.8	25.7	28.7	27.0	27.7	28.7	20.5	23.9
5.	100 to 2000	33.7	31.0	33.3	30.0	32.1	33.5	25.3	25.0
6.	Miller Planters	37.1	37.1	37.6	35.4	36.9	37.3	27.0	32.7

Note : The year 1980 is the cyclone year, and may be discarded.

Only 0.6% fall in the Category of above 20 arpents and below 100 arpents.

- (ii) The yield gap between the small and Miller planters is high. It varies from 7.7 to 10.7 tonnes per Arpent depending upon the sub-division of the small planters.

The quality and yield of sugarcane vary from category to Category, besides varying from region to region due to different climatic, topographical, soil and other conditions. Besides there is wide disparity of circumstances, resources, facilities and infrastructure among the different categories of the planters. The lower yields in case of small planter is mainly due to marginal, economically unproductive, rocky or slopy lands and in some cases waste land or erosion soils.

Table No. 3 gives the yield of Sugarcane/Arpent for the years 1973 to 1981 in case of different categories of planters.

3.2 Cultural Practices

The cultural practices depend upon soil types and topography and vary from category to category of the planters.

3.2.1 Land Preparation & Field Operations

To ensure good yields usually 10% of the cane area is replanted in case of miller planters and large planters. The fields to be replanted are usually ripped, derocked, disc harrowed and finally furrowed for planting. Depending upon soil conditions these operations are carried out by means of crawler tractors or wheel tractors. Land preparations for medium size planters are carried out by their own tractors and equipment, while that for the small planters it is carried by the Sugar Planters' Mechanical Pool Corporation and to a limited extent by miller planters tractors or private contractors.

3.2.2 Planting

There are two periods of planting in Mauritius. The first being the period from January to May known as intercrop plantation and the second the period July/August known as crop plantation. Plant canes of intercrop plantation are harvested after 16/17 months while the plant canes of crop planting are harvested after 12-14 months. The ratoon canes are harvested after 12 months. Planting operations are carried out manually.

3.2.3 Varieties

Miller-planters and large planters have their own nurseries, which are carefully maintained, safeguarding these against propagation of pest and diseases, and mixing of varieties. Most of the small planters use own cane crop as planting material or take from

the neighbour's field unless they have to change varieties in which case they depend upon the large planters or Miller-Planters. Small Planters tend to plant cane varieties which are high-yielding and not the one having high sucrose contents. The large planters and miller-planters rigidly follow the varietal composition recommended by Mauritius Sugar Industry Research Institute (MSIRI), while the small planters tend to be rather conservative to changing the varieties.

The Table No. 4 shows MSIRI's varietal recommendation sheet No. 25 for 1984. This gives an idea of the varieties prevalent in Mauritius.

The Tables No. 5 (a) and 5 (b) give details of cane varieties planted in miller-planter's land in the five regions as also in the island for the years 1979 to 1983.

Photographs Nos. 1 & 2 show the Sugarcane breeding at the Mauritius Sugar Industry Research Institute. Photograph No. 3 shows the latest variety M 3035/66.

3.2.4 Fertilisation

The miller-planter and most of the large planters follow the fertilization schedule recommended by MSIRI. At planting time available phosphates, potash, silicon and soil acidity are determined by soil analysis. Requirements in Nitrogen, Phosphates and potash in ratoon canes are determined by foliar diagnosis. The use of calcium silicates in soils which are deficient in silicon is now a current practice on the large sugar Estates. Ammonium Sulphate is the main inorganic fertilizer, and average application being 40 kgm. per arpent in two doses in plant as well as ratoon canes. Water insoluble phosphates and rock phosphates are recommended to be applied only at planting time at a rate varying from 125 to 250 Kgm P_2O_5 per arpent. Triple or single super phosphates - soluble phosphates are also used in the furrow as a booster. Potash is used as muriate of potash mainly at planting time and in the form of compound fertilizers in ratoon. The annual rate of application ranges from 40 to 75 Kgms K_2O per arpent. The Graph No.1 gives an idea of the inorganic nutrients NPK applied per arpent and its relation to cane yield/arpent for the years 1945 to 1979. Fertilization is done manually.

3.2.5 Irrigation

Irrigation has been prescribed ever since sugarcane has been cultivated in the dry regions of island. In the earlier days the irrigation requirements were met with from natural springs, streams or rivers in the proximity of the plantations. La Ferme and La Nicoliere were constructed in the year 1921 and 1926 respectively with the specific objective of providing irrigation water to the Sugar Industry.

Table 4

Sugar Cane Varieties Recommended for Different Soil Types and Harvest Periods

Soil Type	Harvesting Period		
	Early	Middle	Late
Latosolic Brown Forest (B1/B2)	M 356/53 M 13/56 ¹ M 574/62 ² G M 2370/62	M 31/45 M 356/53 M 574/62 ² G M 2370/62 M 2173/63 G M 657/66 M 3035/66 ^{2 3} G	M 356/53 M 555/60 ¹ G M 126/63 ^{1 3} M 2173/63 G M 657/66 M 3035/66 ^{2 3} G
Humic Ferruginous Latosols (F1/F2)	M 356/53 M 574/62 ² G M 2370/62 M 2173/63 G M 657/66 S 17 ¹	M 356/53 M 574/62 ² G M 2370/62 M 2173/63 G M 657/66 M 3035/66 ^{2 3} G	M 356/53 M 555/60 ¹ G M 2173/63 G M 657/66 M 3035/66 ^{2 3} G
Humic Latosols (H1/H2)	B 51129 ¹ M 13/56 ¹ M 574/62 ² G S M 2370/62 S M 657/66 S S 17 ¹	B 51129 ¹ M 93/48 M 356/53 S M 13/56 ¹ M 2173/63 G M 657/66 S S 17 ¹ M 3035/66 ^{2 3} G	B 51129 ¹ M 356/53 S M 555/60 ¹ G M 126/63 ^{1 3} M 2173/63 G M 657/66 S M 3035/66 ^{2 3} G
Low Humic Latosols (L1)	M 13/56 M 2173/63 ³ G S S 17	B 51129 M 356/53 S M 13/56 M 2173/63 G S S 17 TRITON	M 356/53 S M 555/60 G M 126/63 ³ M 2173/63 G S TRITON
Low Humic Latosols (L2)	M 356/53 S M 2173/63 G S M 657/66 ³ S S 17	B 51129 ³ M 356/53 S M 13/56 M 2173/63 G S M 657/66 S S 17 TRITON	B 51129 M 356/53 S M 555/60 G M 126/63 ³ M 2173/63 G S M 657/66 S TRITON
Latosolic Reddish Prairie (P1/P2)	M 13/56 M 2173/63 G S S 17	M 13/56 M 555/60 G M 2173/63 ³ G S M 657/66 S S 17 TRITON	B 51129 M 555/60 G M 126/63 ³ M 2173/63 ³ G S M 657/66 S TRITON
Latosolic Reddish Prairie (P3)	M 13/56 M 173/63 ³ G S S 17	M 13/56 M 555/60 G M 2173/63 ³ G S M 657/66 S S 17 TRITON	B 51129 M 555/60 G M 126/63 ³ M 2173/63 G S M 657/66 S TRITON

1. Variety to be planted only in low altitude soils.
2. Variety should be planted only in specific areas of superhumid zone as given in annexure.
3. Provisional recommendation.
- G Variety susceptible to gummosis and should not be planted in immediate vicinity of M 377/56 and in areas prone to the disease.
- S Variety susceptible to smut, all necessary precautions should be taken prior to planting.

Varieties M 124/59, M 1227/62 and M 94, 63 are not recommended at present because of gumming disease and M 376/64 because of smut.

Table 4 (contd)

Localities where M 574/62 and M 3035/66
may be cultivated

Sector	Factory's Area	Locality
East	Fuel	Providence Montagne Blanche Sans Souci
Centre	Mon Desert-Alma	Quartier Militaire Valetta
	Highlands	Belle Rive Hermitage
	Reufac	Henrietta Beard
South	Rose Belle	Midlands Bananes Eau Bleue
	Britannia	Beau Climat La Flora Bois Chéri
	Bel Ombre	Chamarel*
	Union St. Aubin	Bois Sec Beau-Bois Combo
	St. Felix	Luchon Cascade Chamouny

* Only for M 574/62

(Source : Mauritius Sugar Industry Research Institute)

Table 5 (a)

Cane Varieties Cultivated on Miller-Planters' Land 1976-1983
(% area cultivated)

	M 31/45 (1955)	M 202/46 (1959)	M 93/48 (1959)	M 442/51 (1964)	M 13/56 (1966)	M 377/56 (1966)	M 351/57 (1970)	S 17 (1970)	M 124/59 (1971)	M 438/59 (1971)	M 356/53 (1974)	B 51129 (1974)	Triton (1976)	M 555/60 (1976)	M 574/62 (1976)	M 1227/62 (1977)	M 376/64 (1977)	M 2173/63 (1978)
1976	3	1	10	1	23	17	4	34	2	2	-	-	-	-	-	-	-	-
1977	3	1	10	1	24	18	3	33	2	2	1	1	-	-	-	-	-	-
1978	3	-	10	-	26	19	2	29	2	1	1	2	1	-	-	-	-	-
1979	3	-	10	-	28	18	1	26	2	1	2	3	2	1	1	-	-	-
1980	3	-	9	-	28	18	-	23	2	1	2	3	2	2	2	1	1	1
1981	3	-	9	-	28	16	-	18	2	1	3	3	3	3	4	1	1	2
1982	4	-	9	-	26	14	-	16	2	1	3	3	2	4	6	1	1	3
1983	4	-	8	-	25	11	-	13	2	1	4	3	2	6	8	1	1	3

N.B. Year of approval of variety by Cane Release Committee is given in brackets

Table 5 (b) Contd

VARIETIES	EAST					SOUTH					CENTRE				
	1979	1980	1981	1982	1983	1979	1980	1981	1982	1983	1979	1980	1981	1982	1983
M 31/43	15.3	24.0	9.1	7.3	3.5	3.9	2.3	1.0	0.3	0.2	0.8	2.9	-	-	-
M 93/48	6.4	13.8	11.2	3.2	4.5	5.4	3.2	3.0	2.1	3.9	48.1	35.2	23.6	3.8	0.6
M 356/33	3.4	5.7	8.1	3.6	5.4	6.3	4.0	5.0	7.7	8.5	9.6	9.4	4.0	5.4	2.5
M 13/56	35.6	24.1	26.0	13.1	14.8	38.8	31.6	22.7	16.3	12.2	4.4	-	-	-	-
M 377/56	2.0	6.3	-	-	-	9.0	4.3	0.1	-	-	2.0	0.1	-	-	-
M 351/57	-	-	-	-	-	0.7	-	-	-	-	-	-	-	-	-
M 124/59	6.7	3.8	12.8	3.8	-	0.8	1.1	0.7	-	-	-	-	-	-	-
M 438/59	-	-	0.1	-	-	0.6	-	0.8	-	-	-	0.1	-	0.2	-
M 555/60	2.1	3.4	3.8	17.6	12.4	1.3	1.5	3.6	7.5	10.4	2.7	1.6	2.1	11.1	1.6
M 574/62	-	2.3	9.1	29.8	15.7	9.1	21.0	21.9	18.1	12.6	18.7	35.4	48.7	41.6	29.2
M 1227/62	0.3	0.7	1.8	-	0.3	3.0	3.5	1.8	0.4	0.2	-	-	-	-	-
M 2173/63	0.9	1.3	2.5	10.8	15.2	2.1	11.6	16.5	18.2	13.9	3.2	10.4	15.3	20.9	15.2
M 376/64	9.4	3.1	0.4	0.2	-	2.6	-	-	-	-	2.3	-	-	-	0.1
B 51129	8.9	3.9	7.0	1.1	1.1	2.1	1.3	0.5	0.7	0.1	-	-	-	-	-
Triton	6.8	4.4	4.6	1.9	0.5	2.0	2.0	1.6	-	-	-	-	-	-	-
S 17	1.4	1.8	2.9	4.6	9.0	4.4	4.7	12.6	9.5	8.1	7.6	2.5	-	3.8	7.7
Other Varieties	0.8	1.4	0.6	3.0	17.6	7.9	7.9	8.2	19.2	29.9	0.6	2.4	6.3	13.2	43.1
Total area planted (ha)	1084	1546	1417	1114	1119	1992	1876	1904	1818	1936	615	647	693	504	715

Table 5 (b)
Cane Varieties Planted on Miller-Planters' Land 1979-1983
(% area planted)

VARIETIES	ISLAND					WEST					NORTH				
	1979	1980	1981	1982	1983	1979	1980	1981	1982	1983	1979	1980	1981	1982	1983
M 31/43	5.0	8.0	2.7	2.0	0.9	-	-	-	-	-	-	-	-	-	-
M 93/48	9.5	9.3	7.0	2.1	2.7	-	-	-	-	-	-	-	-	-	-
M 356/33	5.4	4.4	4.7	4.8	5.0	1.1	1.0	0.5	-	-	4.5	1.1	1.3	0.3	-
M 13/56	33.0	23.1	20.9	14.9	11.5	16.1	5.1	19.1	27.2	25.7	41.7	26.8	25.5	17.4	9.9
M 377/56	8.8	6.1	0.3	-	-	2.0	-	-	-	-	22.4	15.2	1.4	-	-
M 351/57	0.5	-	-	-	-	3.4	-	-	-	-	0.2	-	-	-	-
M 124/59	2.3	2.3	5.1	1.9	-	7.3	8.4	9.2	0.9	-	0.2	1.6	4.5	7.2	0.2
M 438/59	0.2	0.4	0.3	-	0.1	-	1.1	-	-	1.3	-	1.8	-	-	-
M 555/60	4.3	7.8	9.4	16.2	17.2	17.1	26.1	19.8	22.9	15.2	9.7	24.7	29.3	44.9	57.5
M 574/62	6.5	12.5	16.9	20.0	13.5	-	-	-	-	-	2.4	1.6	3.4	1.2	2.8
M 1227/62	2.4	3.0	1.3	0.2	0.1	8.7	15.4	-	-	-	2.9	3.0	1.1	0.1	-
M 2173/63	1.8	7.1	11.7	16.1	15.7	2.8	12.1	18.9	12.0	22.2	0.8	3.6	10.1	18.6	19.2
M 376/64	3.8	1.7	0.8	0.7	-	2.7	6.7	1.5	-	-	1.7	1.8	3.4	5.4	-
B 51129	2.9	2.0	2.3	0.9	0.3	0.9	7.0	4.4	2.0	-	0.5	0.1	-	1.4	-
Triton	6.8	5.2	4.7	0.9	0.8	35.4	5.9	13.9	4.1	8.4	12.0	15.8	10.3	-	0.8
S 17	3.0	2.5	5.2	7.3	7.8	-	0.5	-	16.9	15.9	-	-	-	-	2.1
Other Varieties	3.8	4.6	6.7	12.0	22.4	2.5	10.7	12.7	14.0	11.3	1.0	2.9	9.7	3.5	7.5
Total area planted (ha)	4967	5396	5417	4380	4829	299	346	412	457	302	977	982	990	487	757

PHOTOGRAPH No. 1.



Left : Crossing Lanterns, past and present;
SUGARCANE BREEDING AT THE MAURITIUS
SUGARCANE INDUSTRY RESEARCH STATION.

PHOTOGRAPH No. 2



Crossing in greenhouse

SUGARCANE BREEDING AT THE MAURITIUS SUGAR INDUSTRY RESEARCH STATION



BOOM-O'-RAIN (top); TARGET MASTER (bottom)
OVER-HEAD IRRIGATION IN MAURITIUS.

There had been an increasing trend as regards irrigation of the cane cultivations. There had been steady increase in surface irrigation till 1973, but this was slowly replaced by overhead irrigation. The area under the intensive overhead irrigation increased steadily from 1970 to 1975 and reached a peak of 24,500 arpents in 1977. Although there has been decrease in the area under intensive overhead irrigation due to higher energy cost during the year 1980 and 1981, but the area under the occasional overhead irrigation increased considerably during the same period. Of late drip irrigation is coming up. Pilot schemes are already in operation. In addition some of the large planters have also converted their plantations to drip irrigation. Encouraging results have been obtained and it is hoped that this system will become popular. For the benefit of the planters, Government is operating a scheme in the North covering a majority of small planters plots. The Photograph No. 4 shows the overhead irrigation.

3.2.6 Weed Control

Weeds in sugarcane crop is quite a serious problem, as the weeds take the nutrients, which if uptaken by the plant will obviously contribute towards its higher yields. A number of imported herbicides have been tried and are used. It has been experienced that MCPA and 2,4-D derivatives in combination with Sodium Chlorate are more effective in dry regions, while herbicides like Atrazine and DCMU give better results in wet regions. Mixture of Actril-DS and DCMU or Atrazine is found to be very effective and economical for most of the sugarcane weeds. Velpar K 4 is more commonly used in ratoons. The removal of weeds and application of weedicides is done manually.

3.2.7 Cane Diseases & Control

- (a) Bacterial diseases : (i) gumming
(ii) leaf scald
(iii) red stripe
- (b) Virus diseases : (i) ratoon stunting
(ii) chlorotic streak
- (c) Fungal diseases : (i) red rot
(ii) pineapple disease
(iii) smut.

With the exception of ratoon stunting and chlorotic streak which occurred for the first time in the 1950's, disease incidence was low because of natural factors and varietal resistance.

The gumming disease has been responsible for the disappearance of several varieties in the past. The disease was brought under control when a new and virulent strain of pathogen attacking commercial varieties was discovered in 1964 following the occurrence of two cyclones. A strict programme

of replacement of susceptible varieties by resistant ones had brought the disease under control. But in 1981 gumming disease again appeared when a new strain of the bacterium developed.

An outbreak of leaf scald also occurred in 1964. This disease also was attributed to variability of the pathogen. To overcome this disease varieties with acceptable level of resistance were therefore recommended for plantation.

The fungus disease - yellow spot spread in 1970's and had caused considerable loss in superhumid areas. The disease causes loss of sucrose in canes while in late maturing varieties yield is affected. Susceptible varieties were almost completely replaced by resistant ones. Pineapple disease is controlled by regular fungicidal treatment of cane setts at planting. Smut disease used to be a problem in dry areas but is now well under control. Treatment of cane-setts with hot water at 52°C for 20 to 30 minutes brings the disease under control.

3.2.8 Cane Pests & Control

Over forty species of insects, almost all of which are of foreign species, feed on sugarcane. Fortunately only a few are chronic pests. The scale insect, which is serious one, appeared in the drier regions of the island in 1960's. The insect infests the stems of sugar cane causing considerable reduction in sucrose content. Another important chronic pest is the spotted borer, which attacks cane shoots of all ages causing appreciable reductions both in cane yields and sucrose content. In young cane, small shoots are killed by this borer.

Another sporadic pest, called the Pou a Pache Blanche, *Pulvinaria icery* a leaf - infesting insect, appeared in the middle of the 19th century. It then disappeared but a new outbreak of this pest considerably affected the 1977 crop. It thus constitutes a serious threat to the Sugar Industry.

Soil pest include insects, organism related to insects and nematodes. These damage the root growth.

Rats cause considerable damage to matured canes in fields where there are piles of stores, lying in field as a result of derocking.

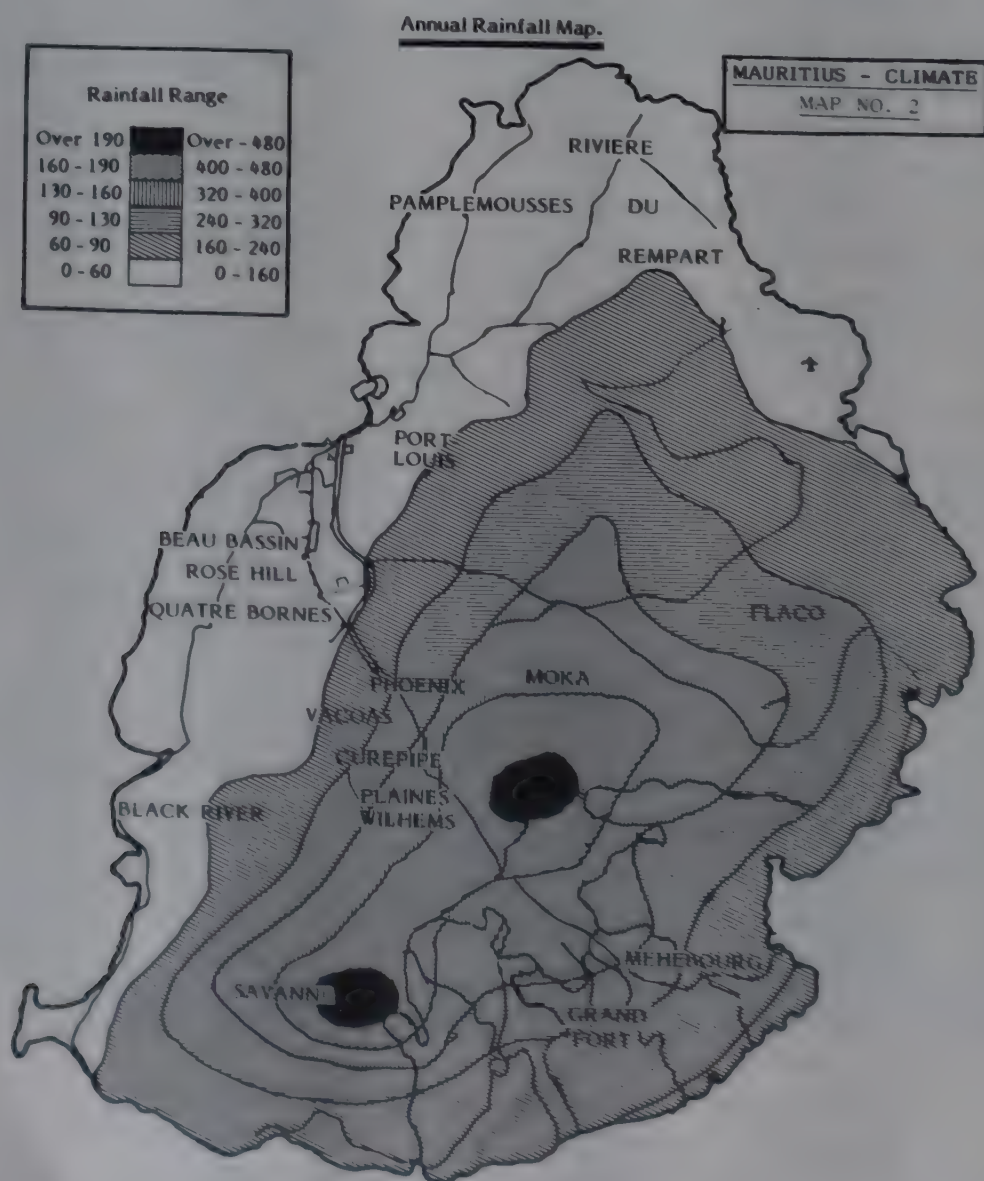
Control methods for the variety of existing cane pests are of cultural, biological or chemical nature. It needs to be pointed out, however, that insecticidal control of most cane pests is not practicable, therefore insecticides are used only to a limited extent

3.2.9 Mechanisation

The mechanisation of a certain number of operations have proved vital for the survival of the Sugar Industry. Three main operations, viz. land

Table No. 6
Areas harvested and yields 1983 Crop
A - Area (Ha) B - Yields (Tonnes/ha)

	ISLAND		WEST		NORTH		EAST		SOUTH		CENTRE	
	A	B	A	B	A	B	A	B	A	B	A	B
Miller-Planters												
(a) Virgin Canes												
(i) Grande Saison	2338	110.3	337	100.4	354	121.2	535	116.1	778	112.1	334	95.5
(ii) Petite Saison	1520	84.2	63	68.5	103	74.2	520	85.1	756	86.5	78	80.7
(b) Ratoons												
1st Ratoon	5166	85.6	410	72.2	701	86.6	1494	86.6	1844	89.1	717	80.9
2nd Ratoon	5044	76.6	336	67.6	712	74.1	1522	79.0	1831	77.8	643	75.2
3rd Ratoon	4634	75.6	327	69.7	692	70.7	1143	76.6	1861	79.4	611	70.8
4th Ratoon	4741	72.4	326	66.5	641	67.4	983	72.6	2126	76.4	665	66.5
5th Ratoon	4921	70.0	305	58.4	805	60.2	1138	74.2	2112	73.8	561	67.1
6th Ratoon	3517	69.0	236	54.0	538	58.1	724	70.7	1460	75.3	559	67.1
Older Ratoons	10100	70.1	893	65.3	1207	62.0	2553	67.6	3964	75.8	1483	69.5
I. Total Miller-Planters	41981	76.3	3233	67.6	5753	71.4	10612	77.6	16732	79.9	5651	73.3
II. Total Owner-Planters	34642	56.7	2240	50.0	13850	55.1	7971	56.1	6818	62.5	3763	57.4
III. Total Tenant-Planters	1812	47.8	-	-	-	-	872	42.4	845	53.6	95	45.1
TOTAL & AVERAGES	78435	67.0	5473	60.4	19603	59.9	19455	67.2	24395	74.1	9509	66.7



preparation, transport of cane to the mills and cane loading have been mechanised. Powerful crawler tractors were introduced in the fifties and this increased the area under cultivation by derocking the fields. Such tractors are self-owned in case of miller-planters and large planters but are available to small planters on contract basis through The Sugar Planters' Mechanical Pool. Mechanical loading is becoming more common, at present about 40% of the harvested cane is loaded mechanically. Mechanical harvesting, however, is not very much prevalent, not more than 1.5% of the total cane produced is mechanically harvested. It is experienced that mechanical harvesting increases the foreign matter in cane particularly the trash. This has a detrimental effect on the factory efficiency.

3.2.10 Maturity & Ripeners

The sucrose contents gradually increase from June to October and then starts declining which much depends upon the climatic conditions. Early and late maturing varieties are cultivated with a view to have a more evened-out sugar extraction % cane. Of late chemical ripeners have been used on an industrial scale with advantage of early maturity i.e. in the month of May. Early ripeners not only increase sucrose contents in cane, but also help in starting the campaign early and finish early i.e. before the recovery starts declining sharply.

3.3 Area under Cultivation

(Area under this section has been mentioned either as Hectare or Arpent. For the convenience of the readers the equation is given hereunder :

1 Hectare = 2.37 Arpents = 2.47 Acres)

Out of the total area of the island i.e. 186,500 Hectares (441,800 Arpents), more than half of this area is under cultivation excluding the forest plantation etc. Sugarcane alone covers more than 90% of the total area under cultivation i.e. about 98,000 Hectares (approx. 232,000 arpents). Rest i.e. about 10% is occupied by tea, tobacco and vegetable etc.

The following 4 Tables show :

Area harvested and yields 1983 crop in the different regions and in the island (Table No. 6)

Yield of Cane and Sugar produced for the period 1979-83 for the miller-planters, planters for the different regions and the island. (Table No. 7)

Area under sugarcane and area harvested for the years 1979-83 in different regions and for the island. (Table No. 8)

Sugar production in the different regions and for the years 1979-83. (Table No. 9)

Table No. 10 gives the yield gap between the Miller-planter and other categories of planters.

It will be observed that the yield gap between the Miller-planter and large planter is 5.1 tonnes with a range of 3.4 to 7.7, while the yield gap between Miller-planter and small planter is 9.5 with a range of 8.5 to 12.6.

The Table No. 11 gives the comparison of relative yields of cane produced, calculated on the basis of miller-planters yield as 100 working out prorata, the corresponding figures for the other categories.

It would be seen that the highest yields are in case of Miller-planters, the large planters occupy the second place and the small planters the third place. Again in case of four sub-categories of small planters the very small planter is occupying quite a favourable position as compared to the other three sub-categories. The lowest efficient group is that of planters cultivating cane from 5 Arpents to 20 Arpents.

It could be inferred that the small planters are mostly self-employed, and they work hard in the field and achieve good yields. Further the planters under the category 5.0 to 19.99 Arpents do not appear to do well due to inadequate facilities, infrastructure and the resources viz-a-viz the size of the holdings, and they do not work themselves.

4.0 Factory

4.1 Capacity & Crushing Rate

The present milling capacity of the industry on the island basis is around 2500 TCH. Taking at least 22 hrs. of crushing per day and 130/135 days of nett crushing season the industry has an annual milling capacity of 7.0 to 7.5 million tonnes of cane, which is about 10% above the peak crop achieved in the year 1982. There are presently 21 numbers sugar factories and Map No. 3 shows the location and crushing capacity in tonnes cane per hour. It would be seen that the nominal crushing capacity ranges from 60 tonnes of cane per hr. (TCH) to 250 TCH. The capacity classification is as under :

Nominal Capacity Range (TCH)	No. of Factories
Above 150 and upto 250	4
Above 100 and upto 150	8
Above 50 and upto 100	9
TOTAL	21

Table No. 7
Yield of Cane and Sugar Manufactured
98.5° Pol 1979-1983

(Tonnes/ha)

	1979		1980		1981		1982		1983	
	Cane	Sugar	Cane	Sugar	Cane	Sugar	Cane	Sugar	Cane	Sugar
ISLAND										
Miller-Planters	88.3	9.64	64.0	6.69	77.5	8.42	91.0	9.53	76.3	8.80
Planters	67.4	7.37	49.4	5.16	54.7	5.94	72.1	7.55	56.3	6.49
Average	79.2	8.65	57.7	6.03	67.8	7.35	82.4	8.62	67.0	7.73
WEST										
Miller-Planters	88.2	10.40	73.4	8.37	77.3	8.86	101.2	11.44	67.6	8.08
Planters	66.6	7.89	60.5	6.90	53.9	6.18	81.2	9.18	50.0	5.97
Average	79.6	9.41	68.2	7.78	67.8	7.78	93.9	10.52	60.4	7.22
NORTH										
Miller-Planters	90.1	9.90	70.6	7.54	68.9	7.74	101.0	10.35	71.4	7.87
Planters	67.5	7.44	52.7	5.63	45.8	5.23	75.0	7.68	55.1	6.08
Average	76.4	8.43	59.8	6.39	55.5	6.23	82.8	8.49	59.9	6.61
EAST										
Miller-Planters	86.4	9.10	58.9	5.87	76.8	8.09	88.4	8.98	77.6	8.95
Planters	64.0	6.75	42.1	4.20	54.5	5.74	66.2	6.72	54.8	6.32
Average	76.2	8.03	51.2	5.11	66.6	7.01	78.5	7.98	67.2	7.75
SOUTH										
Miller-Planters	87.9	9.48	64.7	6.68	81.4	8.78	88.9	9.43	79.9	9.50
Planters	70.8	7.65	51.6	5.32	66.4	7.17	72.8	7.72	61.5	7.32
Average	82.9	8.96	61.0	6.29	77.1	8.32	83.9	8.90	74.1	8.81
CENTRE										
Miller-Planters	90.7	10.28	56.8	5.99	79.6	8.54	86.5	9.23	73.3	8.23
Planters	68.8	7.82	45.6	4.81	59.7	6.40	68.8	7.35	57.1	6.41
Average	81.5	9.24	52.2	5.51	71.5	7.67	79.5	8.48	66.7	7.49

Table 8
Area under Sugar Cane 1979-83
(in thousand ha)

Year	Area under cane	Area harvested					
		Island	West	North	East	South	Centre
1979	85.70	79.72	5.31	20.36	19.77	24.25	10.03
1980	85.54	79.14	5.35	20.16	19.36	24.36	9.91
1981	84.70	78.29	5.30	19.75	19.34	24.29	9.61
1982	84.90	79.91	5.36	20.16	19.91	24.63	9.85
1983	84.39	78.44	5.47	19.60	19.46	24.40	9.51

FLACQ UNITED ESTATES LIMITED
MAURITIUS

PHOTOGRAPH No. 5.



Union Flacq Factory -
BIGGEST MILL IN MAURITIUS - CAPACITY 250 TCH

MAP SHOWING SUGAR ESTATES IN MAURITIUS

MAP No. 3



CAPACITY TCH OF 21 NO'S SUGAR ESTATES

Table 9
Sugar Production 1979-83
(in thousand tonnes)

Crop	No. of factories operating	Av. Pol	Island	West	North	East	South	Centre
1979	21	98.8	688.4	50.3	170.9	158.4	216.6	92.2
1980	21	98.8	475.5	41.7	128.3	98.5	152.8	54.2
1981	21	98.7	574.5	42.8	122.7	135.3	201.8	71.9
1982	21	98.7	687.9	56.2	170.7	158.9	218.7	83.4
1983	21	98.7	604.7	39.5	129.1	150.5	214.8	70.8

Table 10
The Yield/Arpent and Yield Gap

Year	All Planters Less Than 100 Arpents	Miller Planter	Yield Gap*	Large Planters	Yield Gap**
1973	27.3	37.1	9.8	33.7	3.4
1974	24.5	37.1	12.6	31.0	6.1
1976	28.5	37.6	9.1	31.3	4.3
1977	26.7	35.4	8.7	30.0	5.4
1978	28.4	36.9	8.5	32.1	4.8
1979	28.7	37.3	8.6	33.5	3.8
1981	23.2	32.7	9.4	25.0	7.7
MEAN	26.8	36.3	9.5	31.2	5.1

- Notes :**
1. Years 1975 & 1980 have been omitted being cyclone years.
 2. *Between Miller-Planters and small planters
 3. **Between Miller-Planters and large planters.

Table 11

Category/ Year	1973	1974	1976	1977	1978	1979	1980	MEAN
Miller/Planter	100	100	100	100	100	100	100	100
0.01 to 0.99 Arp.	73.0	66.8	78.5	78.8	81.0	80.4	76.5	76.4
1.00 to 4.99 Arp.	72.5	65.5	76.6	77.1	79.1	78.3	72.2	74.5
5.00 to 19.99 Arp.	71.7	64.4	72.9	71.2	72.9	73.2	67.3	70.5
20.00 to 99.99 Arp.	80.3	69.3	76.3	76.3	75.1	76.9	73.1	75.3
Above 100 Arpent	90.8	83.6	88.6	84.7	87.0	86.1	79.2	85.7

The St. Felix Sugar Estate has the lowest capacity of 60 tonnes cane per day, while the Flacq United Estates Limited has the highest capacity of 250 tonnes cane per day.

Photographic view of Union Flacq Factory is shown (Photograph No. 5). The Table No. 12 shows the crushing capacity of each factory and the crushing rate.

It would be seen that the total crushing rate of the industry in the years 1981 and 1982 are 2382 and 2452 respectively as against present nominal capacity of 2500 TCH. The year 1982 may be considered as the normal year and during this year the crushing is only 2% less than the nominal capacity.

4.2 Overall Mill Operating Efficiency

The Table No. 13 gives the data as regards length of the season, nett crushing hours per day, overall time efficiency, mechanical time efficiency for The Year 1971 to 1982.

It would be seen that the overall time efficiency covers stoppages due to both lack of cane and mechanical breakdown whereas mechanical efficiency relates to stoppages resulting from mechanical breakdown only.

It would be further observed from the said Table that the down-time for lack of cane had been comparatively less during the years 1981 and 1982, reportedly due to better cane supply as a result of mechanical loading of cane. Analysis of each factory reveal that Riche en Eau, Beau Champ, Mon Desert Alma and Bel Ombre experienced shortages of cane. By reducing the down time of a cane shortage by about 50% the industry could crush an additional quantity of cane to the extent of 400,000 tonnes or so in one normal season.

There had been higher mechanical down-time from the years 1976 onwards. Reportedly the foreign matter, stones etc. consequent to mechanical loading had been mostly responsible for the machinery breakdowns. However with proper vigilance these breakdowns are under control and down time on this score are comparatively less during the last two years.

It may be interesting to compare the mechanical time efficiency of Mauritian sugar mills with the sugar mill in Australia, South Africa and other African countries.

The Table No. 14 enclosedr gives the relative data.

It would be seen that the mechanical time efficiency is quite comparable with Australia and

higher than that of South Africa and other countries.

4.3 Factory Performance

The performance of sugar factory, besides the mechanical time efficiency is gauged by the following efficiency indices :

(i) Reduced Mill Extraction

Mill Extraction reduced to a common basis of fibre contents taken as 12.5%.

(ii) Reduced Boiling House Recovery

Boiling house recovery reduced to a common basis of mixed juice purity of 85.0%.

(iii) Reduced Over All Recovery

This index is the product of Reduced Mill Extraction and the Reduced Boiling house recovery and obviously is based on the established figures of Fibre % Cane as 12.5% and the Mixed Juice purity as 85.0%. This index is indicative of the overall performance of a factory.

4.4 Mill House Performance

The Table No. 15 compares the Mill Extraction performance of the Mauritian sugar industry for the last twelve years with the Australian and the South African Industry.

It would be observed that while the Mill Efficiency (Juice Extraction) of the Mauritian Sugar Industry is quite comparable with the Australian Sugar Industry, it is comparatively lower than that of the South African Industry. Considering the Reduced Mill Extraction Index of the Mauritian sugar industry as a whole and individually it may be added that the efficiency has been just maintained but there is no appreciable upward trend in this respect. While the average Reduced Mill Extraction for the 21 mills is 96.0% in the year 1981 the variation in the industry is from 95.5% to 97.2%.

The Table No. 16, hereunder, compares the mill house performance of the Mauritian sugar industry with other countries.

The above mentioned projections call for specific improvement in this area by installation of modern and efficient preparatory devices and latest mill components.

4.5 Boiling House Performance

The Table No.17 (a) compares the boiling house performance of the Mauritian sugar industry with the Australian and the South African Industry.

The Table No. 17 (b) below would indicate the boiling house and the overall performance of the Mauritian Sugar factories for the periods 1971-74, 1976-79 and 1981-82. While compiling this, the cyclone years have been eliminated.

Table 12

Nominal Capacity & Average Crushing Rate

Average Grinding Rate

Factory	Nominal Capacity TCH	1981	1982
Fuel	250	234	240
Medine	175	167	170
Beau Champ	175	179	173
Mon Desert Alma	160	151	156
Belle Vue	150	131	144
Mon Loisir	145	125	139
Riche en Eau	120	118	117
Savannah	120	113	121
Constance	120	107	118
Union St. Aubin	110	108	109
Mon Tresor	110	103	104
St. Antoine	110	100	104
Highlands	100	98	97
Rose Belle	100	97	98
Britannia	90	92	91
Beau Plan	90	87	90
Reufac	80	83	84
The Mount	80	85	88
Solitude	80	77	82
Bel Ombre	70	68	71
St. Felix	60	59	58
Total	2495	2382	2454
Average	118.8	113.5	116.9

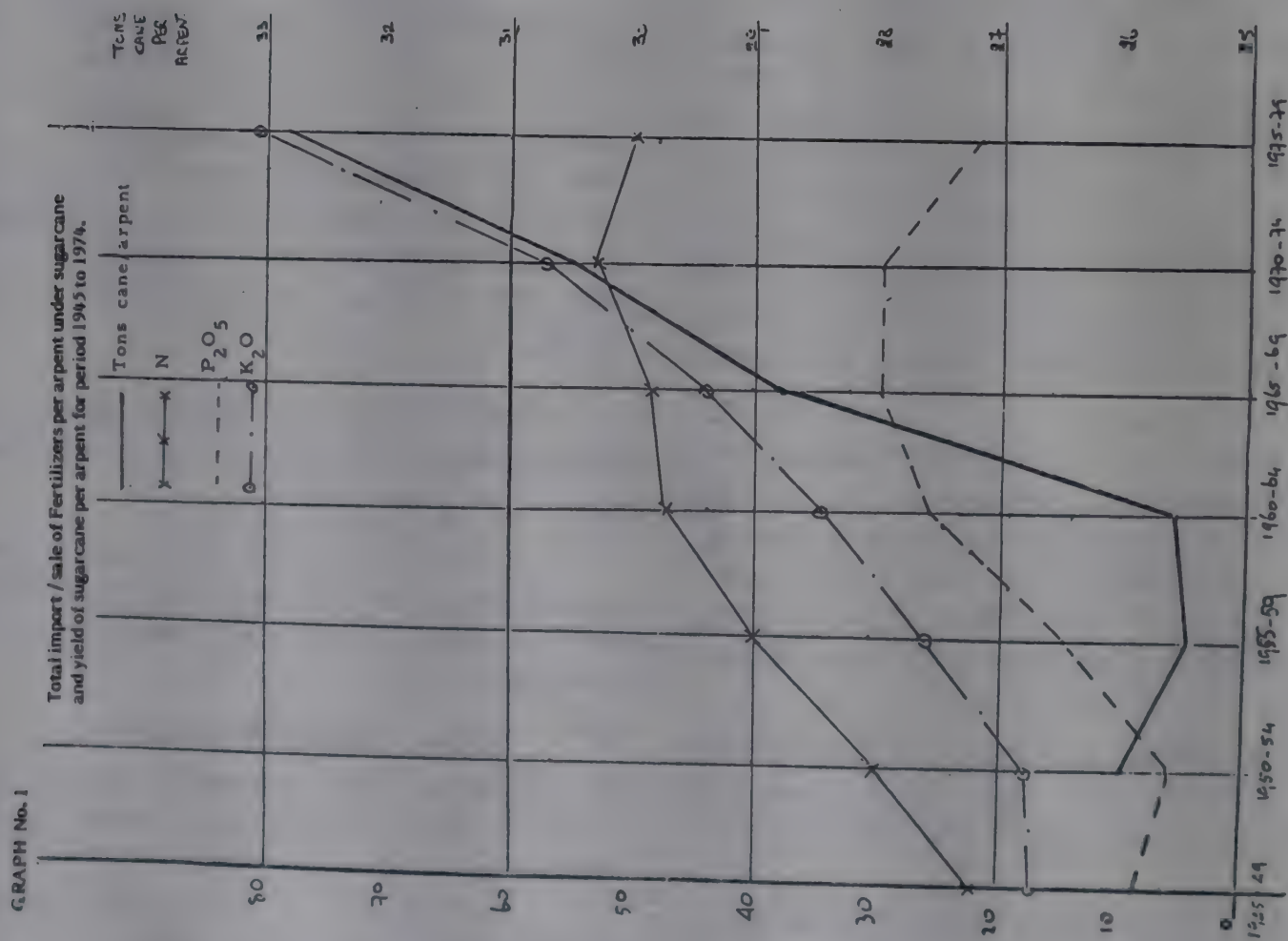


Table 13
Overall Mill Operating Efficiency

Years	No. of Crushing days	Net Crushing hours per day	Hours Stoppage per day		Overall Time Efficiency %	Mechanical Time Efficiency %
			Technical Breakdown	Lack of Cane		
1971	111	20.39	0.74	2.87	85.0	96.5
1972	132	20.28	0.56	3.16	84.5	97.3
1973	129	20.32	0.70	2.98	84.7	96.7
1974	126	20.22	0.79	2.99	84.3	96.2
1975*	118	16.78	0.62	6.60	69.9	95.4
1976	144	19.05	0.94	4.01	79.4	95.3
1977	137	19.27	1.34	3.39	80.3	93.4
1978	137	19.50	1.47	3.03	81.3	93.0
1979	136	19.95	1.53	2.52	83.1	92.9
1980*	104	19.41	1.45	3.14	80.9	93.1
1981	109	20.48	1.39	2.13	85.3	93.8
1982	130	20.59	1.16	2.25	85.8	94.2
1971-1974**	125	20.30	0.70	3.00	84.6	96.7
1976-1979**	139	19.44	1.32	3.24	81.0	93.7
1981-82**	120	20.53	1.28	2.19	85.5	94.0

* Cyclone years in Mauritius

** Average of years in question

Table 14
Comparative Statement of Mechanical Time Efficiency

Sr. No.	Country	Year	Mechanical Time Efficiency	Remarks
1.	Mauritius	1981	93.8	21 mills
		1982	94.2	
2.	South Africa	1980-81	91.13	17 mills
3.	Swaziland - Malawi - Zimbabwe	1980-81	90.63	7 mills
4.	Australia	1980-81	94.93	30 mills

Table 15
Mill House Performance of the Mauritian Sugar Industry
as Compared to the Australian and South African Sugar Industries

Year	Tonnes Cane per hour			Tonnes Fibre per hour			Water % Fibre			Reduced Mill Extraction		
	Mauritius	S/Africa	Australia	Mauritius	S/Africa	Australia	Mauritius	S/Africa	Australia	Mauritius	S/Africa	Australia
1971	108.7	164.1	217.09	14.3	24.32	29.24	218	277	-	95.9	96.64	96.10
1972	112.4	169.51	222.87	14.5	25.12	30.46	211	279	-	95.9	96.35	96.23
1973	113.7	170.23	231.68	15.1	26.62	31.84	218	288	-	96.1	96.57	96.14
1974	111.6	168.78	241.24	14.3	26.31	34.76	214	286	-	96.1	96.51	95.98
1975*	103.7	191.35	264.96	14.5	29.98	37.20	218	279	-	96.0	96.45	95.86
1976	111.2	211.84	299.64	14.5	31.46	42.38	211	281	-	96.1	96.48	96.02
1977	109.0	221.40	325.57	14.9	33.41	45.77	214	302	-	96.0	96.85	96.21
1978	111.5	233.60	333.99	15.4	33.78	45.55	203	314	-	96.0	97.32	96.51
1979	110.7	234.75	332.53	15.3	34.61	46.31	197	333	-	96.0	97.60	96.60
1980*	107.5	224.86	341.13	15.8	34.16	46.43	202	344	-	96.0	97.66	96.57
1981	113.5	-	-	15.9	-	-	207	-	-	96.0	-	-
1982	116.8	-	-	16.1	-	-	203	-	-	96.2	-	-

*Cyclone years in Mauritius

Table 16
Comparative Statement of Mill House Performance

Sr. No.	Country	Year	Mill Extraction	Reduced Mill Extraction	Remarks
1.	Mauritius	1981	95.5	96.0	} 21 mills
		1982	95.6	96.2	
2.	South Africa	1980-81	97.0	97.1	17 mills
3.	Swaziland - Malawi - Zimbabwe	1980-81	96.0	95.6	7 mills
4.	Australia	1980-81	96.2	96.2	30 mills

Table 17 (a)

**Boiling House Performance of the Mauritian Sugar Industry
as Compared to the South Africa and Australian Industries**

Year	Sucrose lost in Mollasses			Boiling House Efficiency			Reduced Boiling House Efficiency		Reduced Overall Recovery	
	% Sucrose in Cane			S/Africa Australia **			Mauritius	S/Africa Australia	Mauritius	S/Africa Australia **
	Mauritius	S/Africa	Australia	Mauritius	S/Africa	Australia				
1971	6.69	8.43	5.91	98.8	89.41	-	88.2	90.81	84.7	87.76
1972	7.07	8.46	5.70	98.9	89.48	-	89.5	87.90	85.8	84.68
1973	7.11	8.96	6.50	98.9	89.13	-	89.1	88.50	85.7	85.46
1974	6.99	9.26	6.21	98.6	88.76	-	88.6	88.76	85.1	85.66
1975*	7.44	9.52	5.52	98.8	88.68	-	88.0	88.94	84.4	85.78
1976	7.64	8.45	5.89	98.7	88.99	-	88.9	89.41	85.4	86.26
1977	7.75	8.77	5.84	98.6	88.62	-	88.6	89.13	85.1	86.32
1978	8.05	8.16	6.18	98.5	89.58	-	88.9	89.24	85.3	86.85
1979	8.12	8.59	6.33	98.6	89.48	-	88.8	89.14	85.2	87.00
1980*	7.74	9.46	6.45	98.4	88.17	-	88.4	88.35	84.8	86.28
1981	7.54	-	-	98.3	-	-	88.5	-	85.0	-
1982	7.48	-	-	98.7	-	-	89.1	-	85.7	-

* Cyclone years in Mauritius

** Data presently not available

Table 17(b)

Sr.No.	Period	Reduced boiling house Recovery	Reduced Overall Recovery
1	1971-74	88.85	85.30
2.	1976-79	88.80	85.25
3.	1981-82	88.80	85.35

A closer study of the above two Tables together would indicate scope of some improvement in the boiling house performance. From years to years there seems to be almost a stable performance; in fact a downward trend is noticeable.

4.6 Overall Performance

The Table No. 18, hereunder, compares the average performances indices in the Mauritian sugar factories for the year 1981 with the average of the years 1977-81.

Table No. 18
Performance Indices

Sr.No.	Efficiency Index	Average 1977-81	Year 1981
1.	Reduced mill extraction	96.0	96.0
2.	Boiling house recovery	90.0	89.8
3.	Reduced boiling house recovery	88.7	88.5
4.	Overall recovery	86.1	85.7
5.	Reduced overall recovery	85.1	85.0

The above Table again indicates the scope of improvements particularly in the boiling house, in which case the efficiency figures are comparatively low than the average of the 5 years i.e. 1977 to 1981.

4.7 Performance of Individual Sugar Mills

The individual factories in Mauritius are showing significantly different performance. The range of variance in performance is projected in the Table No. 19(a), 19(b) and 19(c).

It would be seen from the above mentioned Tables that a wide variance exists in the efficiency indices on examining the three key efficiency indices for the years 1970 to 1981, it would be revealed that while Mount, Highlands and Beau Plan factories are showing high efficiency indices, Reufac, Rose Belle and Fuel factories are showing low performance.

5.0 Sugar Manufacturing Process

5.1.0 General

Sugar is manufactured in Mauritius presently in twenty-one sugar factories. Out of the twenty-one sugar factories seventeen sugar factories are exclusively making raw sugar, polarising around 98.5, by means of the Standard Defecation Process. Four sugar factories partly/fully manufacture refined sugar, polarising around 99.6 and above, by adopting generally the Lime-Phosphotation of the remelt.

Mauritius produces annually about 700,000 tonnes of sugar of which approximately 40,000 tonnes are plantation white sugar, 6,000 to 10,000 tonnes of refined sugar, 4,000 tonnes of Demerara sugar and balance is standard raw sugar.

5.2.0 Processing of Cane

A brief description of the main operating steps in the processing of cane is given hereunder, and has been shown in a Typical Flow Chart.

5.2.1 Cane Transport & Handling

The cane is mainly delivered to the factories by road transport by different types of equipment viz; detachable bins, tractor drawn vehicles fitted with winches and wire ropes, truck tippers, bullock carts etc. The cane, on arrival at the factory, is weighed on cane weighbridges. The unloading of cane is done either by means of over-head travelling cranes or electric/steam engine driven derrick cranes.

5.2.2 Cane Preparation

Before milling of the cane, the cane is prepared by passing through set of cane cutters and a shredder which break open about 80% of the tissue cells without extracting the juice.

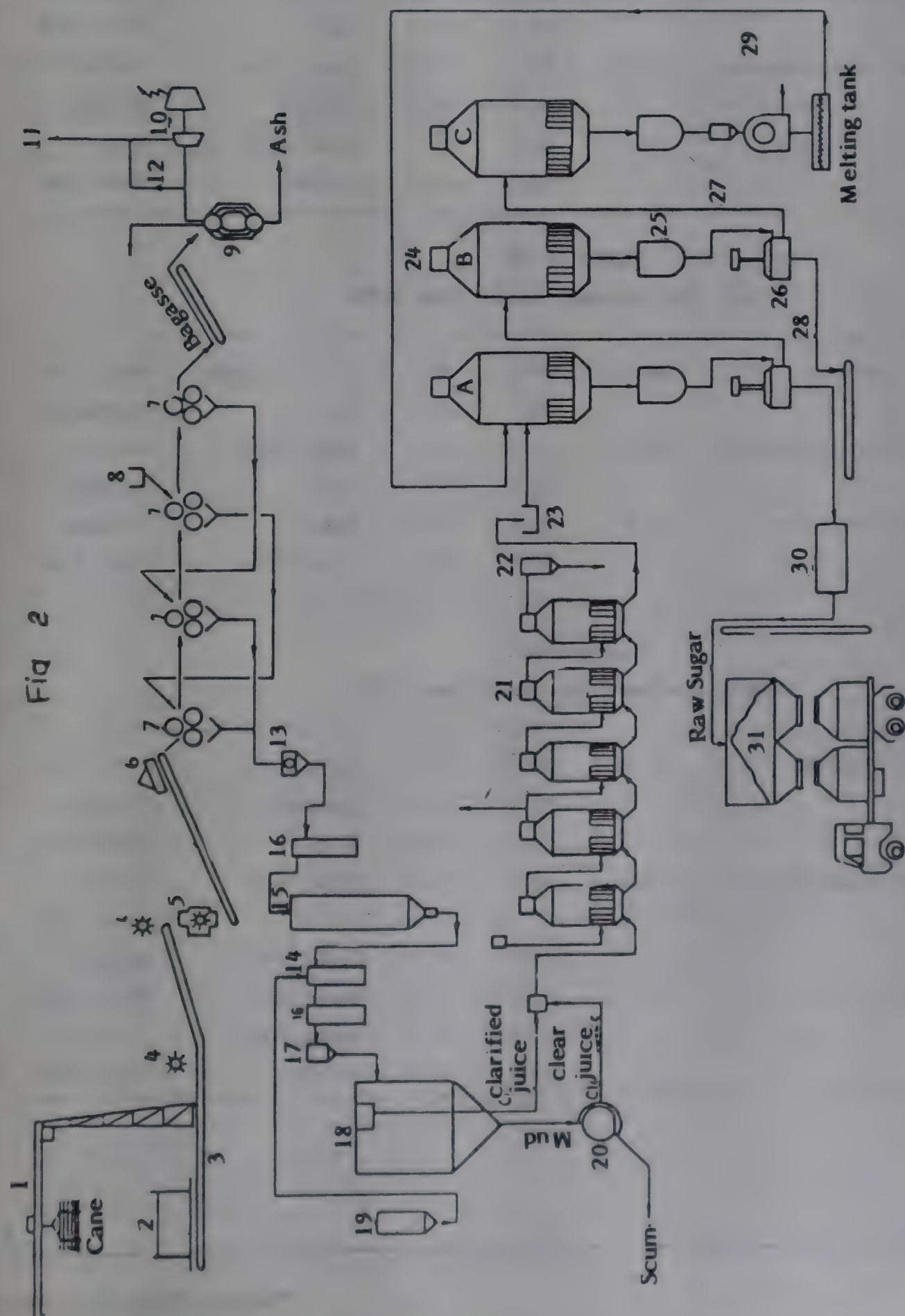
5.2.3 Extraction

The prepared cane is fed through a mill tandem composed of four to seven three-roller mills which extract the juice, leaving behind a fibrous residue known as bagasse. Simultaneously water is added to the bagasse mat before the last mill and the juice extracted by that mill is recirculated to the bagasse entering the previous mill and so on, so as to obtain a counter-current washing of the bagasse as it moves along the mill tandem, thus improving the extraction of sucrose from the cane. This process is known as Compound imbibition. In some cases sometimes hot water imbibition is practiced for reducing sugar losses in bagasse.

Twenty sugar factories, out of twenty-one, adopt the above mentioned conventional method of extraction of juice. Only one factory, St Antoine has adopted the diffusion system, which is a combination of crushing mills and a diffuser, known as Saturn Diffuser.

TYPICAL FLOW CHART OF A SUGAR FACTORY IN MAURITIUS

Fig 2



1	Travelling Crane
2	Feeder Table
3	Cane Carriers
4	Cane Cutters
5	Shredder
6	Magnetic Separator
7	Mills
8	Imbibition water
9	Boiler
10	Turbo - Alternator
11	Exhaust Steam
12	Steam Pressure Reducer
13	Juice Scale
14	Liming Tank
15	Enzymatic Tank
16	Juice Heaters
17	Flash Tank
18	Clarifier
19	Lime Preparation Station
20	Rotary Vacuum Filter
21	Evaporator
22	Barometric Condenser
23	Syrup Tank
24	Vacuum Pans
25	Crystallizers
26	Centrifugals
27	Runnings
28	Sugar
29	Final Molasses
30	Sugar Drier

Table 19 (a)
Factory Performance Variance (Basis Year 1981)

Sr. Index No.		Index Variance			Name of Factory	
		Average	Low	High	Low	High
1.	Reduce Mill Extraction	96.0	95.2	97.2	Reufac	Highland
			95.5	96.8	Fuel	Beau Plan
2.	Reduced boiling house recovery	88.5	86.2	90.5	Rose Belle	Mount
			86.7	90.2	Reufac	Solitude
3.	Reduced overall recovery	85.0	82.3	87.3	Rose Belle	Mount
			82.5	86.9	Reufac	Beau Plan

Table 19 (b)
Factory Performance (Basis Year 1980)

1.	Reduced Mill Extraction	96.0	95.1	97.2	Union St. Aubin	Beau Plan
			95.2	97.1	Fuel	Highlands
2.	Reduced Boiling house recovery	88.4	85.9	91.1	Rose Belle	Solitude
			86.0	90.8	Fuel	Mount
3.	Reduced overall recovery	84.8	81.9	87.5	Fuel	Solitude
			82.0	87.5	Rose Belle	Beau Plan

Table 19 (c)
Factory Performance (Basis Year 1979)

1.	Reduced Mill Extraction	96.0	95.0	97.5	Rose Belle	Beau Plan
			95.2	97.3	Savannah	Highlands
			95.3	96.9	Fuel	Mon Loisir
2.	Reduced boiling house recovery	88.8	85.9	90.6	Rose Belle	Mount
			-	90.4	-	Beau Plan
			86.7	90.4	Belle Vue	Solitude
3.	Reduced overall recovery	85.2	81.6	88.1	Rose Belle	Beau Plan
			83.6	87.3	Belle Vue	Mount
			83.7	87.2	Reufac	Highlands

5.2.4 Clarification and Filtration

After weighing, the juice is sent to the clarification section where it is limed to a pH of 8.0 and heated to 105°C, thus precipitating colouring matter, organic acids, albuminoids and a miscellaneous suspended matter. The limed juice is then allowed to settle in the clarifier where the precipitates move to the bottom and are extracted as mud, while the clear juice goes to the evaporators. The mud is filtered and washed in rotary filters and the resulting by-product which is known as filter cake is disposed off as manure in cane fields. The wash water of the filter is put back in the process.

5.2.5 Evaporation

The clarified juice is evaporated in a multiple effect evaporator to a syrup of about 60° brix.

5.2.6 Boiling, and Centrifuging

Syrup is evaporated under vacuum to such a concentration that sugar crystals form out of the solution. This mixture of crystals and molasses is known as A-massecurite. It is centrifuged in a basket lined with a screen which allows the A-molasses to pass through it, while retaining the A-sugar. The A-molasses is further boiled into a B-massecurite from which B-molasses and B-sugar are similarly separated. The B-molasses is boiled into a C-massecurite from which C-molasses and C-sugar are obtained. It is uneconomic to recover any further sugar from C-molasses and the latter, known as final molasses, is marketed/exported for the production of alcohol, animal feed etc. A and B-sugars are exported as commercial raw sugar. Their purity is of the order of 99.0. C-sugar has a purity of 85 and is remelted and is reprocessed by boiling and crystallisation.

5.2.7 Sugar Handling

The commercial raw sugar is dried in sugar dryers and transported to Sugar Bulk Terminal after weighment. Special sugars and refined sugars are stored in hoppers fitted with discharge chutes and scales for weighing the sugar. Such sugars are packed for marketing.

5.2.8 Steam Generation

Bagasse is burnt in boilers equipped with specially equipped furnaces in order to produce steam for the factory requirements. The live steam (high pressure steam) is issued for the prime movers of cane cutters, shredder and mill drives, turbo-alternator and for any other drives installed in the factory. The prime movers utilise live steam from the boilers and exhaust it at 1 bar for the process. The exhaust steam is used by juice heaters, evaporators, vacuum pans and for miscellaneous small demands in the process of sugar manufacture.

5.2.9 Refined White Sugar Manufacture

A-sugar from the raw sugar process is given additional washing in the centrifugal machines and then melted with the hot condensate. The melted liquor is clarified by adding phosphoric acid and lime and passing through a clarifier. The clarified liquor is then boiled in the refinery vacuum pans. The resultant massecurite is discharged into a receiver and then centrifuged in the refinery centrifugal machines. Three boilings are done from the melt liquor and run-offs. The sugar is dried, screened and any metallic (ferrous) articles removed by an electro-magnet. The refined sugar is weighed and bagged.

6.0 Factory Plant & Machinery

6.1.0 Cane Handling

All the factories are equipped with automatic weighbridges with printing devices. Only in three of the factories the weighing operations are computerised.

6.1.2 Cane Unloading

Canes are handled either by travelling cranes, and derricks or combination of both. There are about two dozen of travelling cranes and about the same number of cane derricks in the industry. A number of factories still have steam-driven derricks. These derricks are very old but are well maintained and giving good service.

6.1.3 Cane Preparation

The factories are equipped with either 2/3 sets of cane knives, one set of cane knives or two sets of cane knives with a shredder in most of the factories. There are about a dozen of cane shredders already operating successfully. Two sets of knives followed by a shredder gives a high preparation index.

6.1.4 Tramp Iron Separators

Quite a few factories have installed magnetic devices for removal of tramp iron before the cane enters the mills.

6.2.0 Extraction Plant

6.2.1 Mills & Diffuser

Mills in Mauritius are generally old in design. In two of the factories most modern mills are installed viz; Highlands and Belle Vue. Latest hydraulic mills have been installed at Saint Aubin Sugar Estate recently. Modern equipment viz; lotus rolls have been installed in some factories. Only in one factory diffuser has been installed. The installations in twenty-one factories are as under :

- Six factories have 4 mills
- Eleven factories have 5 mills
- Two factories have 6 mills
- One factory has 7 mills

Table No. 20
Summary of Chemical Control Data 1983
(i) Cane Crushed and Sugar Produced

Crushing Period		6/7	6/7	8/7	1/7	18/7	8/7	15/7	29/6	15/6	23/6	17/6	24/6	22/6	20/6	28/6	25/6	27/6	7/6	1/7	25/6	18/6	-
From		21/10	24/9	8/10	21/11	10/11	27/10	5/11	28/10	28/11	14/11	2/11	15/11	11/11	22/10	31/10	1/12	18/11	21/10	6/11	15/10	13/10	-
To		90	67	76	115	95	91	92	101	137	114	113	118	117	104	104	131	119	114	104	94	97	106
Number of Crushing Days																							
Net Crushing Hours Per Day		21.82	22.11	23.09	22.17	20.55	20.13	21.03	22.08	20.81	20.64	20.43	21.04	21.43	21.21	22.45	19.45	21.97	20.44	20.10	20.86	9.95	21.08
Hours Stoppages Per Day		1.28	0.22	0.61	0.34	1.31	1.75	0.59	1.04	2.47	1.99	1.01	1.90	1.50	2.28	0.98	2.52	1.42	1.90	0.85	1.26	1.34	
Overall Time Efficiency		90.9	92.1	96.2	92.4	85.6	83.9	87.6	92.0	86.7	86.0	85.1	87.7	89.3	88.4	93.5	81.0	91.5	85.2	83.8	86.9	83.1	87.6
Mechanical Time Efficiency		94.4	99.0	97.4	98.5	94.0	92.0	97.3	95.5	89.4	91.2	95.3	93.5	93.5	90.3	95.8	88.5	93.9	91.5	95.9	95.8	94.1	94.0
Cane Crushed (Tonnes)																							
Miller-Planters		220365	36522	48792	142253	148005	79937	148442	142024	418375	263803	227689	209993	207190	145292	142896	267194	46489	91853	113789	114900	183727	3399530
Planters		111271	78146	96484	62707	118272	111428	99518	101393	262941	119720	40511	36377	85098	66658	68038	6847	99583	68055	5495	67622	96971	1855135
Total		331636	114668	147276	204960	266277	191365	247960	243417	681316	383523	268200	246370	292288	211950	210934	274041	146072	159908	169284	18252	2280698	6254565
Factory % Total		66.4	31.9	33.1	69.4	55.6	41.9	59.9	58.3	61.4	68.8	84.9	85.2	70.9	68.6	67.7	97.5	31.8	67.4	67.2	63.0	65.5	84.0
Per Day		3685	1711	1938	1782	2803	2103	2695	2410	4973	3364	2374	2088	2498	2038	2028	2092	1228	1403	1628	1942	2894	2366
Per Hour Actual Crushing		168.9	77.4	83.9	80.4	136.4	103.3	128.2	109.1	238.9	163.0	116.2	99.2	116.6	96.1	90.4	107.6	55.9	68.6	80.8	93.0	145.0	112.3
Percentage Varieties																							
Crushed (Miller-Planters only)																							
M 13/56		19.4	42.4	30.4	28.9	22.6	47.9	-	24.2	30.9	37.5	36.8	55.6	43.6	7.4	19.5	7.0	32.3	48.4	4.8	24.6	-	26.8
S 17		19.7	0.8	1.5	4.7	12.2	-	-	16.9	2.0	19.6	16.3	5.1	21.3	18.3	10.7	28.3	11.2	22.4	20.7	25.4	-	10.6
M 377/56		13.0	20.0	20.0	28.9	20.7	7.2	-	14.1	7.6	6.7	8.9	19.4	5.9	77.8	0.4	7.1	7.1	3.5	15.2	7.5	-	10.2
M 93/48		-	-	-	-	-	-	-	-	13.0	0.7	-	-	1.0	19.7	19.1	2.6	0.1	-	20.3	9.6	-	-
M 574/62		0.1	0.6	3.0	2.7	1.0	-	-	1.1	9.0	2.3	6.2	0.8	4.3	17.2	14.9	8.1	5.4	7.2	8.6	3.8	6.0	7.1
M 555/60		10.5	18.5	6.9	7.0	26.3	27.5	-	6.4	5.7	3.2	2.0	6.5	0.1	1.4	0.5	-	-	4.1	2.6	0.1	2.8	-
M 2173/63		5.8	0.9	9.4	5.2	0.7	2.6	-	4.1	0.8	3.2	6.1	9.6	3.8	1.9	5.8	8.8	4.1	3.2	-	12.7	6.3	4.8
M 31/45		-	-	-	-	-	-	-	0.8	19.1	3.8	0.6	-	1.2	16.1	2.2	0.4	0.3	-	-	-	-	-
M 356/53		0.3	3.0	1.5	5.3	3.5	0.1	-	5.3	0.6	4.4	1.1	0.7	0.7	0.1	22.0	3.6	21.4	1.5	-	5.9	-	-
B 511/29		2.4	0.3	-	2.4	1.0	0.1	-	5.0	4.5	9.7	5.0	0.8	5.0	-	0.4	6.5	9.3	0.9	-	-	-	-
Trifton		6.8	7.8	10.2	0.7	4.3	5.0	-	6.6	0.9	3.4	1.9	0.5	0.9	-	-	2.7	2.3	3.1	-	-	-	-
M 124/59		7.5	2.2	0.5	0.7	0.5	8.3	-	12.2	3.8	1.1	1.2	0.1	0.6	0.4	3.2	0.3	-	-	0.6	-	-	2.4
Other Varieties		14.5	3.5	16.6	13.5	7.2	1.3	-	3.3	2.1	4.4	16.9	0.9	11.7	9.7	1.3	23.6	6.5	5.7	2.6	11.3	3.3	8.2
Sugar Produced (Tonnes)																							
Raw Sugar		39540	11141	16750	23940	15570	12364	27914	29404	66371	38445	30581	30136	35590	22789	25053	33545	17358	19820	19411	22085	29270	667077
White Sugar		-	-	-	-	13433	7972	-	-	8403	7930	-	-	-	-	-	-	-	-	-	-	-	37738
Total Sugar		39540	11141	16750	23940	29003	20336	27914	29404	74774	46375	30581	30136	35590	22789	25053	33545	17358	19820	19411	22085	29270	704815
Total Sugar at 96° Pol		40570	11453	17274	24617	30136	20969	28691	30154	76986	47494	31504	30921	36497	23455	25761	34438	17849	20374	19936	22739	-	621954
Cane/Sugar Ratio																							
Tonne Cane / Tonne Sugar		8.39	10.29	8.79	8.56	9.18	9.41	8.88	8.28	9.11	8.27	8.77	8.18	8.21	9.30	8.42	8.47	8.42	8.07	8.72	8.26	9.59	8.69
Tonne Cane / Sugar made																							
at 96° Pol		8.17	10.01	8.53	8.33	8.84	9.13	8.64	8.07	8.85	8.08	8.51	7.97	8.01	9.04	8.19	7.96	8.18	7.85	8.49	8.03	9.31	8.45

One factory has 3 mills and a diffuser.

The mills are generally driven by modern steam turbines. Only one milling tandem comprising five mills in one sugar factory is driven by five individual electric motors. In small factories some mills are still being driven by steam engines, while in others steam turbines are installed. The position of mill drives is as under :

Steam engines	-	6
Steam turbines	-	67
Electric motors	-	5

6.3.0 Steam Generation Plant

The old and small factories are still working with inefficient fire-tube boilers, fifty seven in number, operating between 6 and 11 bar steam pressure. Sixteen factories have water-tube boilers, thirty-one in number, operating at a steam pressure ranging between 17.0 and 31.0 bar.

6.4.0 Power Generation Plant

The factories are generally equipped with multi-stage back pressure, Turbo-generators with an internal efficiency of about 0.8 and operating with an inlet steam pressure ranging 7.9 to 25.2 bar. Two factories are equipped with pass out/condensing turbo-generator used mainly for sale of electric energy to the grid. In all 49 turbo-alternators are operating in the industry.

Quite a few factories have installed a stand-by generating set which produces surplus energy and sell to public grid.

6.5.0 Juice Heaters

In all 109 juice heaters are operating in the industry. These are "shell and tube", mostly horizontal type. Some of the units are very old and obsolete.

6.6.0 Clarifiers

There are 33 clarifiers in 21 sugar factories. These are mostly old in design.

6.7.0 Filters

Twenty-five rotary type filters are in operation in the industry. Fourteen of them are using Rapifloc system which increases the efficiency of the unit.

6.8.0 Evaporation

Most of the factories till 1965 were equipped with quadruple effect evaporators. Four factories, thereafter, installed pre-evaporators to their quadruple effect and six factories have converted their quadruple effect evaporator into quintuple effect evaporators. So far vapour bleeding system for steam economy is not adequately and properly adopted.

6.9.0 Boiling Station

All the factories are equipped with calendria type vacuum pans with the exception of a few which are outdated and old designed coil type pans. The

calendria type vacuum pans are better than coil pans. In 21 sugar factories 139 units are in operation. Only a few low grade sugar boiling pans are equipped with mechanical circulators, which improve the boiling efficiency and exhaustibility. Besides there are continuous vacuum pans working in the island, one for the boiling of the low grade massecuite and the other for the high grade sugar boiling.

Almost all the sugar factories are using common condensing equipment and vacuum pumps which, though workable, is an out-dated system.

6.10.0 Crystallisers

It is a common practice in Mauritius to cool even the high grade massecuites. The crystallisers for the high grade or A & B massecuite are generally of the horizontal water cooled Werkspoor or Blanchard type but some of the factories are still using the conventional air-cooled type crystallisers. The crystallisers in operation for the low grade or C-massecuite are generally water-cooled type. Some factories have adopted the system of continuous cooling of the low grade massecuites in preference to the conventional batch operation. The continuous system gives uniform and better exhaustion consequently less process losses and higher sugar recovery.

6.11.0 Centrifugal Station

Almost all factories have installed automatic batch type centrifugal machines for the curing of A & B massecuites, except one factory which uses 3 Nos. continuous centrifugal machines for B-massecuite. In all 114 units are in operation.

All centrifugal machines for low grade massecuite are continuous type, most of them have been installed around 1970. In all seventy nine machines are in operation. These machines are giving good performance.

6.12.0 Sugar Handling

To meet the standard specifications the raw sugar is dried in sugar dryers, which generally are of horizontal rotary type.

6.13.0 Automation & Instrumentation

Instrumentation has been generally adopted in the important areas of control i.e. boiler, power generation, pan boiling. In order to attain high level of efficiency automation needs to be considered gradually and in due course.

6.14.0 Workshop Equipment

Some of the factories are adequately equipped with workshop machinery and tools, while there are others which do not have adequate facilities for machining and repairing the machinery spares and components.

6.15.0 Laboratory Equipment

Some of the factories are pulling on with old

Table No. 21
Summary of Chemical Control Data 1983
(ii) Cane, Bagasse, Juices, Filter Cake, Syrup and pH Values

CANE		14.08	11.59	12.91	13.07	12.97	12.88	12.63	13.75	12.76	13.65	12.88	13.92	13.51	12.48	13.10	13.59	13.41	14.17	13.14	13.46	12.10	13.16
Succrose %		15.61	16.60	15.57	15.42	16.69	16.54	15.61	15.43	13.81	12.25	13.53	14.45	14.04	13.75	13.52	12.87	15.06	14.47	13.53	13.29	15.35	14.66
BAGASSE		2.27	1.93	1.52	1.54	2.03	2.06	1.33	2.04	2.46	1.80	1.93	2.10	2.01	1.96	1.71	1.76	1.77	2.17	2.08	1.28	1.86	1.95
Pol %		51.3	48.6	48.8	48.4	48.9	52.3	49.6	46.3	50.2	53.1	50.3	48.3	47.2	51.8	48.7	50.6	46.0	49.2	51.0	51.9	50.0	49.8
Moisture %		45.7	48.6	49.0	49.3	48.4	45.0	48.6	51.1	46.7	44.7	47.2	49.0	50.1	45.7	49.1	47.0	51.7	48.0	46.2	46.4	47.4	47.6
Fibre %		34.1	34.2	31.8	31.3	34.5	36.8	32.1	30.2	29.6	27.4	28.7	29.5	28.0	30.1	27.4	27.4	29.1	30.1	29.3	28.7	32.4	30.4
Weight % Cane																							
FIRST EXPRESSED JUICE		20.34	18.20	19.96	19.13	20.33	19.73	19.44	19.70	18.59	19.13	18.64	19.48	19.57	17.65	18.38	19.83	18.75	20.21	18.87	18.62	17.17	19.13
Brix (B1)		85.5	84.7	86.9	88.8	86.3	85.6	88.3	87.7	89.5	89.1	88.6	89.4	89.2	88.6	90.2	90.0	87.9	89.4	88.8	89.6	89.8	88.3
Gravity Purity																							
Reducing Sugars		5.7	5.0	3.5	3.8	2.8	5.0	3.4	4.2	3.0	3.3	3.7	2.9	2.2	3.9	3.1	2.6	4.0	2.7	2.9	2.6	3.8	3.5
Succrose Ratio																							
LAST EXPRESSED JUICE		2.55	3.06	3.46	2.16	3.46	2.98	2.28	2.97	4.52	2.24	2.90	3.28	3.41	2.40	2.14	2.37	2.79	2.49	2.57	1.88	2.64	2.83
Brix		71.1	68.4	68.7	68.1	74.9	76.8	72.9	77.1	78.5	80.4	76.2	78.3	75.1	79.6	76.6	72.2	77.5	78.3	75.7	74.8	72.2	75.0
Apparent Purity																							
MIXED JUICE		95.3	98.2	104.7	109.7	96.9	103.6	97.6	96.1	90.0	97.1	103.2	100.6	106.4	102.1	102.7	102.2	106.7	97.6	97.3	104.4	98.5	99.3
Weight % Cane		16.61	13.48	13.96	13.30	14.90	13.95	14.32	15.76	15.15	15.33	13.72	15.04	14.05	15.24	13.81	14.67	13.87	15.84	14.77	14.22	13.24	14.56
Brix		84.1	82.6	85.0	86.3	85.0	83.8	87.3	86.7	88.2	88.3	87.1	87.9	86.6	87.9	89.1	87.4	87.2	87.5	87.2	88.2	88.1	87.0
Gravity Purity																							
Reducing Sugars/		6.2	6.1	4.2	5.0	4.2	5.4	4.4	5.5	3.9	3.8	4.8	3.4	3.1	4.5	4.1	3.3	5.3	3.2	4.3	3.2	4.5	4.3
Succrose Ratio																							
Qty. pty. drop from		1.4	2.1	1.9	2.5	1.3	1.8	1.0	1.0	1.3	0.8	4.5	2.0	2.6	0.7	1.1	2.5	0.7	1.9	1.6	1.4	1.7	1.3
first expressed juice																							
ABSOLUTE JUICE		19.97	17.03	18.15	18.09	18.46	18.50	17.26	18.86	16.89	17.67	17.21	18.61	18.26	16.53	17.11	17.98	18.20	19.05	17.55	17.69	16.41	17.82
Brix (Ba)		0.98	0.94	0.91	0.95	0.91	0.94	0.89	0.96	0.91	0.92	0.92	0.96	0.93	0.94	0.93	0.91	0.97	0.94	0.93	0.95	0.96	0.93
Ba/B1		83.5	81.6	84.3	85.5	84.3	83.4	86.7	86.2	87.6	88.0	86.6	87.4	86.1	87.5	88.5	86.8	86.8	87.0	86.6	87.8	87.1	86.4
Gravity Purity																							
CLARIFIED JUICE		16.27	12.76	13.23	12.60	13.10	13.67	14.12	14.98	14.65	14.51	13.07	14.27	14.25	12.20	13.16	13.90	12.50	14.19	13.35	13.28	12.94	13.67
Brix		-	83.9	85.0	87.2	85.3	84.9	-	86.8	88.3	88.5	88.1	88.1	88.6	-	89.4	88.6	87.4	87.5	87.9	88.3	86.5	87.2
Gravity Purity		6.4	5.5	3.9	5.0	3.9	5.3	-	4.2	4.0	3.6	3.6	3.3	2.8	3.5	3.8	-	3.8	3.2	3.6	2.8	4.4	4.0
Reducing Sugars/																							
Succrose Ratio		0.91	0.78	1.35	1.59	1.51	2.23	1.08	2.09	1.06	1.85	1.32	1.39	0.84	1.96	2.15	0.71	0.73	2.29	1.76	1.80	1.72	1.45
FILTER CAKE		3.90	3.35	4.95	3.99	4.84	2.36	4.38	3.22	2.92	4.72	4.91	3.25	3.09	4.57	3.78	3.76	3.35	3.08	4.02	4.47	5.35	3.89
Pol %																							
Weight % Cane																							
SYRUP		66.4	60.5	65.0	64.8	62.1	62.3	69.6	63.4	61.3	56.7	69.7	61.2	64.9	69.1	58.6	64.0	64.3	52.0	63.6	62.4	61.2	63.0
Brix 1 : 6 W / W		-	83.7	84.9	87.3	85.7	84.4	-	86.6	87.4	88.2	87.8	88.2	89.0	-	89.3	88.4	87.4	87.4	87.1	88.6	86.6	87.1
Gravity Purity																							
Reducing Sugars/		8.6	4.2	4.1	4.7	4.0	5.7	-	4.2	3.9	3.7	3.7	3.3	2.4	3.7	4.1	2.7	4.1	3.3	3.5	2.7	4.4	4.0
Succrose Ratio																							
pH VALUES		8.1	7.9	8.5	7.5	7.8	7.0	7.4	7.7	8.4	8.4	7.6	-	7.7	8.2	8.1	-	-	8.0	8.0	8.0	8.1	7.9
Lined Juice		7.1	6.9	7.3	7.0	7.1	-	7.1	7.1	7.4	7.3	7.0	7.2	7.4	7.1	7.1	7.6	6.9	7.0	7.4	7.3	7.2	7.2
Classified Juice																							
* Refractometric Brix																							

laboratory equipment viz; Polarimeter, Refractometer, etc. causing inconvenience in the analytical work.

7.0 Rehabilitation and Modernisation

7.1 Cane Handling

7.1.1 Cane Weighment

The cane weighbridges should preferably be modified and the weighing operation computerised. The old and small weighbridges could be replaced with the modern ones.

7.1.2 Cane Unloading

The steam driven derricks are obsolete, costly to maintain and wasteful of steam. These should be modified with electric drives. Preferably heavy duty overhead travelling cranes should be installed in place of obsolete design derricks.

7.1.3 Cane Preparation

The modern trend is to install two sets of knives followed by a Fibrizer, Buster or Shredder for achieving high preparation index and consequently higher Mill Extraction.

7.1.4 Tramp Iron Separator

To avoid break-down of the machinery and down-time iron separators should be installed in all the mills.

7.2 Extraction Plant

7.2.1 Mills

Highlands and Belle Vue have already installed the most modern milling plants. The installation of four-roller mills, pressure feeders, forced feed rollers, Donnelly chutes heavy duty dewatering rolls, lotus rolls should be considered for better Mill Extraction. The steam engine drives should be replaced by the Steam Turbines, preferably by the more sophisticated multistage back pressure turbines with higher internal efficiency and low steam consumption.

7.3 Steam Generation

The fire-tube boilers should be gradually replaced with more efficient water-tube boilers fitted with spreader stocker furnaces and operating at high steam pressure viz; 31.0 to 42.0 bar.

There are more economisers than air heaters.

7.4 Power Generation and Supply of Electric Energy to Grid

Gradually small capacity and low pressure turbo-generators have to be replaced. For the export of power pass out/condensing turbo-generator with high pressure boilers have to be installed.

7.5 Juice Heaters

The old and obsolete juice heaters should be replaced with more efficient modern design vertical type high velocity juice heaters.

7.6 Clarifiers

The present juice clarifiers are of old design. These have high residence time and are responsible for development of colour and for inversion of sugar. Some of the clarifiers need to be modified so as to reduce the residence time while others have to be replaced gradually with the modern clarifiers like Rapi Dorr.

7.7 Filters

The Rapi-floc system should be adopted for increasing the efficiency of the equipment. The basic design of this equipment, however, is satisfactory.

7.8 Evaporation

In the interest of energy production as by-product power the factories should adopt steam saving devices viz; conversion of the quadruple effect evaporator into quintuple effect evaporator with appropriate heating surface in order to be able to bleed steam from the 1st, 2nd, 3rd vessel.

7.9 Vacuum Pans

The modern trend is to instal continuous vacuum pans. Such pans are operating quite successfully in the island. The calendria pans presently operating both on high grade and low grade sugar are well maintained and are giving good service.

For better operation Multijet condensers have to be installed in place of the Conventional Barometric

7.10 Crystallisers

The modern trend is to use continuous crystallisers with cooling/reheating coils of Werkspoor design. This system is a specific improvement over the batch type from the efficiency and operation point of view. The batch type crystallisers should be replaced gradually with continuous type crystallisers with powerful drives to handle heavy massecuites.

7.11 Centrifugal Station

Some of the batch-type machines are very old and those which are not in good condition mechanically need to be replaced at the earliest to avoid accidents. Such inserviceable centrifugal machines should be replaced with more sophisticated micro-processor controlled machines of larger capacity.

7.12 Sugar Handling

The horizontal rotary driers presently installed are suitable for drying sugar to the desired specification.

7.13 Automation

Automation in the areas like, cane feeding of mill, boiler operation, evaporation, boiling and crystallising operation, sugar refining and drying is essential for attaining high level of efficiency and may be adopted gradually.

Table No. 22
Summary of Chemical Control Data 1983
(iii) Magma, Masseccutes and Final Molasses

MAGMA																				
A - MASSECUITE																				
Brix **																				
Apparent Purity																				
Apparent Purity of																				
A Molasses																				
Drop in Purity																				
Crystal % Brix																				
in Masseccute																				
Litres per tonne Brix																				
in mixed Juice																				
A Masseccute %																				
total Masseccute																				
B - MASSECUITE																				
Brix **																				
Apparent Purity																				
Apparent Purity																				
of B Molasses																				
Drop in Purity																				
Crystal % Brix																				
in Masseccute																				
Litres per tonne Brix																				
in mixed Juice																				
B Masseccute %																				
total Masseccute																				
Kg Sugar per cubic																				
meter of A & B																				
C - MASSECUITE																				
Brix **																				
Apparent Purity																				
Apparent Purity of																				
final Molasses																				
Drop in Purity																				
Crystal % Brix in																				
Masseccute																				
Litres per tonne Brix																				
in mixed Juice																				
C Masseccute %																				
total Masseccute																				
FINAL MOLASSES																				
Brix **																				
Sucrose %																				
Reducing Sugars %																				
Total Sugars %																				
Gravity Purity																				
Reducing Sugars																				
Sucrose Ratio																				
Weight % Cane																				
at 85° Brix																				
* Refractometric Brix (1:6 W/W)																				

9.14 Workshop Equipment

The old and inadequate capacity lathe machines, planing machines and other equipment need to be replaced with the latest ones to ensure proper and quick "repairs and spares" service to the sugar factory.

9.15 Laboratory Equipment

In the interest of proper analytical service the obsolete equipment need to be replaced.

9.0 Organisation and Structure

9.1 Ownership

Out of the 21 Sugar Estates, one Estate viz. Rosebelle Sugar Estate is owned by the Government of Mauritius and one by an overseas company and rest are owned by 17 local companies. About 55% of cane lands are owned by these large estates and 45% by some 35000 planters, having holdings varying from a fraction of an hectare to over 400 hectares.

9.2 Associations and Federations

The millers and most of the planters are grouped into the following four associations.

(i) The Mauritius Sugar Producer's Association

This is an Association of all 21 sugar estates and factories. This organisation looks after the interest of the industry and negotiates all problems relating to Sugar Industry with Government, Trade Unions, National Remuneration Board etc.

(ii) The Mauritius Cane Grower's Association

This is an Association of large individual planters producing more than one thousand tonnes of cane. There are about 40 members producing about 500,000 tonnes of cane.

(iii) The Mauritius Sugarcane Planter's Association

This association groups small and large planters producing individually from 10 tonnes to 10,000 tonnes of cane. The association is made up of about 150 members producing some 100,000 tonnes of cane.

(iv) The Mauritius Cooperative Agricultural Federation Ltd.

It represents small planters, grouped into 173 cooperatives producing about 950,000 tonnes of cane. The Federation closely works with the Mauritius Cooperative Central Bank for the crop financing of its members.

9.3 Important Organisations

There are a number of important organisations dealing with/relating to various aspects of sugar industry.

9.3.1 Chamber of Agriculture

This is a private organisation founded in 1853 representing agriculturists, commercial firms, banks and other institutions. Sugarcane Millers, Miller

Planters, Planter's Associations are represented at this chamber. The basic object of this chamber is to promote and safeguard the interest of the agriculturists and the industrialists. It serves Sugar Industry in particular both in Mauritius and overseas. It maintains very elaborate statistics, data bank, costing etc. and represents the sugar industry interest overseas through its London and Broussels Office.

9.3.2 Public Relations Office of Sugar Industry (PROSI)

The Chamber of Agriculture established PROSI in 1968, mainly with a view to maintain relations and improve mutual understanding between the Sugar Industry and all concerned with the industry.

9.3.3 Cane Planter's & Miller Arbitration and Control Board

This board is a statutory body and was set up in 1939 to arbitrate disputes between millers, planters and middlemen and to control the milling of canes and the manufacture of Sugar. Besides it determines and demarcates the cane area of each factory and assesses the quantity of Sugar and products of Sugar accruing to planters and millers. Planters are paid for their cane according to its sugar contents as assessed by the Arbitration and Control Board. The total sugar is estimated from the cane quality (richesse) using either the individual factory performance or the industry's average, whichever is higher. The planter's share is 74% and miller's share 26%. In addition every planter is entitled to receive in respect of each tonne of cane supplied :

- (a) The average quantity of scum produced by the factory per tonne of cane milled during the preceding crop year and
- (b) 74% of the molasses produced by the factory per tonne of cane milled during that crop year.

The planter also gets share out of the bagasse if sold, transferred or utilized for any purpose other than the manufacture of sugar. The planter is entitled to receive out of the value of the bagasse so sold, transferred or utilized an amount equivalent to the fraction represented by the cane supplied by him over the quantity of cane milled in that crop year.

9.3.4 Financing Institutions

There are three main sources of finance to the sugar industry.

- (a) Long term financing is available from the Development Bank of Mauritius, Sugar Industry Pension Fund and insurance companies.
- (b) Mid term loans are available from the commercial banks or from their development corporations for purposes like development/cultivation of new areas, purchase/installation of irrigation or factory equipment etc.

Table No. 23
Summary of Chemical Control Data 1983
(iv) Milling Work, Sugar Made, Sucrose Losses and Balances, Recoveries

	Medline	Solitude	Beau Plan	The Mount	Belle Vue	St. Antoine	Soc Suc	Riv Remp	Constance	F.U.E.L.	Beau Champ	Richen-en-Fau	Mon Tresor	Savannah	Rose Belle	Britannia	Union St.	Aubin	St. Felix	Bel Ombre	Reutac	Highlands	Mon Desert	Totals and Averages
MILLING WORK																								
Imbibition Water	29.4	32.4	36.5	41.0	31.4	40.4	29.7	26.3	19.6	24.5	31.9	30.1	34.4	32.2	30.1	29.6	29.6	29.6	35.8	27.7	26.5	33.0	30.9	29.7
% Cane																								
Imbibition Water	189	195	234	266	188	244	190	171	142	200	236	208	245	234	222	230	238	191	196	196	249	201	205	
% Fibre																								
Extraction Ratio	35.2	34.3	24.1	23.9	32.4	35.6	21.7	29.1	41.3	29.6	31.8	30.8	29.6	34.4	26.4	27.6	25.4	31.9	34.0	34.0	20.5	32.4	31.1	
Mill Extraction	94.5	94.3	96.3	96.3	94.6	94.1	96.6	95.5	94.3	96.4	95.7	95.6	95.9	95.3	96.4	96.5	96.2	95.4	95.4	95.4	97.3	95.0	95.5	
Reduced Mill Extraction	95.8	95.9	97.1	97.1	96.1	95.8	97.4	96.5	94.9	96.3	96.1	96.2	96.4	95.8	96.7	96.6	96.9	96.1	95.8	95.8	97.5	96.1	96.2	
SUGAR MADE																								
White Sugar recovered																								
% Cane																								
Raw Sugar recovered																								
% Cane																								
Total Sugar recovered	11.92	9.72	11.37	11.68	5.84	6.46	11.26	12.08	9.74	10.02	11.40	12.23	12.18	10.75	11.88	12.24	11.88	12.40	11.47	12.40	12.10	10.43	10.79	
% Cane																								
Average Pol of Sugar	11.92	9.72	11.37	11.68	10.89	10.63	11.26	12.08	10.97	12.09	11.40	12.23	12.18	10.75	11.88	12.24	11.88	12.40	11.47	12.40	12.10	10.43	11.51	
Total Sucrose Recovered	98.50	98.68	99.00	98.71	99.76	98.99	98.67	98.45	98.84	98.32	98.90	98.50	98.45	98.80	98.71	98.56	98.72	98.68	98.60	98.60	98.84	98.84	98.72	
% Cane																								
Moisture % Raw Sugar	11.74	9.58	11.26	11.53	10.87	10.52	11.11	11.89	10.84	11.89	11.28	12.05	11.99	10.62	11.72	12.06	11.73	12.23	11.31	12.23	11.96	10.31	11.36	
Dilute indicator of	0.37	0.31	0.28	0.31	0.06	0.38	0.31	0.39	0.32	0.49	0.25	0.35	0.36	0.28	0.31	0.32	0.31	0.30	0.45	0.30	0.27	0.29	0.33	
raw sugar	33.2	30.2	38.3	31.4	19.4	31.7	30.0	33.8	33.1	33.0	29.1	30.3	29.9	30.8	31.6	28.8	31.9	29.6	46.4	31.0	33.0	33.0	33.7	
SUCROSE LOSSES																								
Sucrose Lost in																								
Bagasse % Cane	0.77	0.66	0.48	0.48	0.70	0.76	0.43	0.62	0.73	0.49	0.55	0.62	0.56	0.59	0.47	0.48	0.51	0.66	0.61	0.66	0.37	0.60	0.59	
Sucrose Lost in																								
Filter Cake % Cane	0.04	0.03	0.07	0.06	0.07	0.05	0.05	0.07	0.03	0.09	0.06	0.05	0.03	0.09	0.08	0.03	0.02	0.07	0.07	0.07	0.08	0.09	0.06	
Sucrose Lost in																								
Molasses % Cane	1.25	1.20	0.98	0.91	1.17	1.48	1.10	1.06	0.91	0.94	0.89	0.92	0.80	0.78	0.78	0.80	0.91	1.05	1.00	1.05	0.85	0.87	0.97	
Undetermined Losses																								
% Cane	0.27	0.11	0.12	0.09	0.17	0.07	-	0.11	0.25	0.24	0.10	0.28	0.14	0.40	0.05	0.22	0.24	0.17	0.15	0.17	0.20	0.23	0.18	
Industrial Losses																								
% Cane	1.56	1.34	1.17	1.06	1.41	1.60	1.10	1.24	1.19	1.27	1.05	1.25	0.96	1.27	0.91	1.05	1.17	1.29	1.22	1.29	1.13	1.19	1.21	
Total Losses % Cane	2.33	2.00	1.65	1.54	2.11	2.36	1.53	1.86	1.92	1.76	1.60	1.87	1.53	1.86	1.38	1.53	1.68	1.94	1.83	1.94	1.50	1.80	1.80	
SUCROSE BALANCE																								
Sucrose in Bagasse %																								
Sucrose in Cane	5.47	5.70	3.75	3.67	5.41	5.89	3.38	4.49	5.72	3.62	4.30	4.45	4.17	4.73	3.57	3.55	3.83	4.62	4.64	4.62	2.73	4.98	4.50	
Sucrose in Filter Cake																								
% Sucrose in Cane	0.28	0.23	0.52	0.48	0.56	0.41	0.38	0.49	0.24	0.64	0.50	0.32	0.19	0.72	0.62	0.20	0.18	0.50	0.54	0.50	0.60	0.76	0.43	
Sucrose in Molasses %																								
Sucrose in Cane	8.88	10.32	7.56	6.98	9.04	11.50	8.73	7.70	7.13	6.90	6.91	6.62	5.90	6.28	5.95	5.86	6.80	7.39	7.60	7.39	6.33	7.20	7.36	
Undetermined Losses %																								
Sucrose in Cane	1.92	0.95	0.98	0.67	1.22	0.50	-	0.82	1.96	1.73	0.75	2.05	1.04	3.12	0.38	1.64	1.73	1.18	1.17	1.18	1.51	1.89	1.38	
Industrial Losses %																								
Sucrose in Cane	11.08	11.50	9.06	8.12	10.82	12.41	8.69	9.01	9.33	9.27	8.16	8.99	7.13	10.12	6.95	7.69	8.71	9.07	9.31	9.07	8.44	9.86	9.19	
Total Losses %																								
Sucrose in Cane	16.55	17.20	12.81	11.80	16.23	18.30	12.07	13.50	15.05	12.89	12.46	13.44	11.30	14.85	10.52	11.24	12.54	13.69	13.95	13.69	11.17	14.84	13.69	
RECOVERIES																								
Boiling House Recovery	88.3	87.7	90.6	91.6	88.6	86.8	91.0	90.8	90.1	90.4	91.5	90.6	92.6	89.4	92.8	92.0	90.9	90.5	90.2	90.5	91.3	89.6	90.4	
Reduced Boiling House																								
Recovery (Pty. in 5.85%)	89.1	89.7	90.6	90.6	88.6	87.9	89.1	89.1	86.9	86.8	89.8	88.0	91.6	86.4	89.6	90.0	89.1	88.3	88.1	88.3	88.6	86.2	88.7	
Overall Recovery	83.4	82.7	87.2	88.2	83.8	81.7	87.9	86.5	85.0	87.1	87.5	86.6	88.8	85.2	89.5	88.8	87.5	86.3	86.1	86.3	88.8	85.2	86.3	
Reduced Overall Recovery																								
[Pty. M.L. 85 F % C12.5]	85.3	86.0	88.0	88.0	85.1	84.2	86.8	86.0	82.5	83.6	86.3	84.7	88.2	82.7	86.7	87.0	86.4	84.9	84.4	84.4	86.3	82.8	85.3	
Boiling House Efficiency	98.9	100.7	99.2	99.6	99.7	99.7	98.0	99.2	96.6	97.9	100.1	98.6	100.5	97.2	99.1	100.0	99.1	99.2	99.2	99.2	99.2	99.2	99.2	

- (c) Short term loan is provided by the commercial banks and the Mauritius Cooperative Central Bank for financing the sugarcane crop.

Mauritius Cooperative Central Bank provides finance to all cooperative organisations, and medium level loans for all development projects.

9.3.5 The Sugar Insurance Fund

The Sugar Insurance Fund was established in 1946. The main objective is to ensure the sugar production of the island against losses due to cyclone, droughts, floods, cane fires etc. The insurance is compulsory both for the miller and planters on the value of sugar production as per the apportionment formula of 26% and 74% of the Arbitration and Central Board.

9.3.6 Mauritius Sugar Industry Research Institute (MSIRI)

To give a 'boost' to Agriculture, Station Agronomique was established in 1893. In 1930 a Sugarcane Research Station was formed as a Division of Department of Agriculture to cater to the needs and development of the Sugar Industry. In 1953 a full fledged Sugar Research Institute known as the Mauritius Sugar Industry Research Institute was created. Since then the Institute has been conducting Research in various fields relating to Sugar Industry viz; Plant Breeding, Botany, Pathology, Entomology, Agricultural Engineering, Sugar Technology, Soil and Plant nutrition, Agronomy etc. MSIRI not only supplies new varieties but extends advisory services in all fields. Such services are available to the Millers as well as to the planters.

9.3.7 Government Extension Services

This is an advisory service, the basic objective is to raise the standard of farming through the technical advice and education to the planters. The Extension Service covers about 34000 small planters and is responsible for agricultural training in the rural areas. Under this service there are Regional Demonstration Centres.

9.3.8 Sugar Inquiry Commission

The Mauritian Sugar Industry has been facing economic problems for long due to which there has hardly been any investment or plough back for replacement of obsolete and outdated equipments. Sugar Industry being the back bone of the island's economy, the government was concerned about the declining trend of its efficiency and viability. The problem was considered to be multidimensional and called for thorough investigation and inquiry into all areas and component parts viz.; natural resources and constraints; ownership and structure; organisation and management; manpower and employment; financial and fiscal aspects; marketing and export; technology and research; economics and profitability; public

and industrial relations; by products and diversification and all such other issues relating to the Sugar Industry. A Sugar Enquiry Commission was, accordingly, appointed on 24th December 1982 under the Chairmanship of Dr. Dragoslav Avramovic, Senior Advisor to UNCTAD. To assist the Sugar Enquiry Commission a special unit known as Sugar Sector Study Unit (SSSU) was established in the Ministry of Economic Planning & Development and a Sugar Expert (Mr. H.C. Sood) was appointed from India under the Indian Technical Cooperative Programme on request by the Government of Mauritius. The detailed report of the Enquiry Commission was published in June 1984. The various aspects were analysed, problems identified and global recommendations were made for consideration by the Government of Mauritius.

9.3.9 The Mauritius Sugar Authority

After serious deliberations a new organisation viz.; The Mauritius Sugar Authority was established under the Chairmanship of the Honourable Minister of Agriculture, Mr. Numkeswar Singh Deerpal Singh. It is envisaged that the future development and promotion of the Sugar Industry will be on the "National Basis" and will be in the interest of all concerned - the millers, all categories of planters, all cross-sections of society. The planning of the industry could be done in an integrated manner with advantage like maximum deployment of old machinery and redundant labour, and proper utilization of the cane crop. The by-product development and diversification programmes could also be planned better for the industry as a whole. Keeping all these in view, the Mauritius Sugar Authority has already made 'Action Plan' for the sugar industry as a whole for the period 1985-1990.

9.3.10 Action Plan

The salient features of this plan are :

(a) Agriculture Aspects :

- increasing the field yields
- increasing the area under cane
- increasing the irrigated area and adopting more efficient methods/use of irrigation.
- cultivation of better yielding and resistant varieties.
- encouraging intercropping and crop diversification.
- implementation of results of research and experimentation etc.
- reduce cost of cultivation.

(b) Factory Rationalisation, Rehabilitation & Centralisation

In the past rehabilitation and centralisation of the Sugar Industry had been carried out on private basis and not on the consideration of the overall sectoral and national objectives and constraints. Obviously

the rehabilitation programme of the industry has to be made in the light of its proposed rationalisation. It is further considered necessary to plan rationalisation, rehabilitation and centralisation on the basis of five geographical regions over a period of five years i.e. 1985-1990 as under :

North: Covers six factories viz; Beau Plan, Belle Vue, Mon Loisir, Mount, St. Antoine and Solitude. Solitude factory was proposed to be closed on 1985 and St. Antoine is proposed to be closed by 1990, subject to proper planning as regards diverting and utilisation of cane, safeguarding the acquired rights of all parties concerned and taking care of all other related factors.

East: Covers three factories viz; Beau Champ, Fuel, Constance. Closure of any of these factories is not proposed, but redrawing of boundaries is required with a view to minimise cane transport costs and ensure a more even utilisation of factory capacity and optimise extraction in the region.

Central West : Consists of four factories viz; High Lands, Medine, Mon Desert Alma, Reufac. Out of these four factories, Reufac is proposed to be closed as this is an obsolete plant and beyond the stage of economic rehabilitation.

South West : Consists of three factories viz; Bel Ombre, St. Felix and Union St. Aubin. A number of options have been examined in view of capacity of each factory, geographical location and other related factors. Tentatively the proposal of closure of St. Felix by 1990 is under consideration, although it has not been finally decided.

South East : Consists of five factories viz; Savanna, Rosebelle, Britania, Riche En Eau, Mon Tresor. Out of the five factories, one factory is tentatively proposed for closure by 1990, subject to detailed studies and performance in the coming years.

Broadly speaking, out of 21 sugar factories, two factories have already been closed in 1985 and three more are expected to be closed by 1990. Thus the number of factories may reduce down to sixteen by 1990.

(c) Regional Milling Companies :

It is proposed to have Regional Milling Companies or equivalent organisations for the above five regions. The detailed rehabilitation and centralisation programme will depend upon comprehensive survey of cane areas and component factories. Sample survey has been done in some cases with the World Bank team. Exact programme of rehabilitation and expansion have to be worked out, in the light of indication of the long term possibilities, resulting from the proposed rationalisation in each of the above regions.

The tentative cost of factory rehabilitation, Modernisation and Expansion programme is estimated as under :

	Mauritian Rs. (Millions)
Rehabilitation	253
Modernisation	316
Expansion	68
Total	637

Out of this cost, 60% is estimated to be foreign exchange components.

(d) By-Product Power :

For improving the viability of sugar industry production of by-product power is a 'MUST'. This can be achieved by saving bagasse to the extent of 7-8% on cane, which requires modernisation of equipments and process with a view to minimise steam consumption. Depending upon the technical options exercised and the extent of modern equipment installed and process adopted, the energy production potential from the sugar industry could be in the range of 200 to 300 GWH/year.

10.0 By-Products

There are four by-products of the Sugar Industry viz; bagasse, molasses, filter mud and cane tops. Their approximate annual production is as under :

Bagasse	- 1,850,000 tonnes
Filter mud	215,000 tonnes
Molasses	200,000 tonnes
Cane tops	1,300,000 tonnes

10.1 By-Product Utilisation

10.1.1 Bagasse

Bagasse is mainly used as fuel in boiler furnaces to produce steam for the sugar factory. Bagasse is a very useful by-product. Efforts are made, by modernising the factories to minimise the steam consumption and save bagasse. The surplus bagasse or the surplus steam can be used to produce by-product power. The surplus electricity, not required by the sugar factory, is sold to the grid. Upto 1979, about 2500 tonnes of bagasse was used to produce particle board. A small quantity of bagasse is mixed with molasses to produce animal feed.

10.1.2 Filter Mud

The entire production is utilised as fertilizer in cane fields and is applied in furrows at the time of planting.

10.1.3 Molasses

This by-product finds many uses. While about 87% is exported, the balance is used to produce rum, potable alcohol, industrial alcohol, vinegar and animal feed.

10.1.4 Cane Tops

Cane tops when green and fresh, are mostly used as animal feed.

There are many other usages of the two important by-products viz; Molasses and Bagasse, which are mentioned as under :

Molasses : Fertilizers, animal feed, acetaldehyde, acetone, animal feed, Yeast, Ethyl acetate, Ethenol, Acetic Acid, Baker's Yeast, Citric Acid, Mono Sodium Glucomate Ethylene dichloride etc.

Bagasse : Methane, Furfural, Furfuryl Alcohol, Bleached pulp, Cardboard, Newsprint, Fibre board, writing paper etc.

The most important by-product is the by-product power which can improve the viability/profitability of the industry. A modern sugar factory, for every tonne of cane it crushes, can produce 50 Kwh of surplus electricity and 8 litres of 100° GL alcohol. On the island basis the industry could easily produce 320 GWh yearly and 45 million litres of alcohol.

11.0 Performance in 1983 Campaign

The following Tables are annexed showing the performance of the 1983 campaign :

- (a) Statement of Cane Crushed & Sugar Produced ... Table No. 20
- (b) Statement of Chemical Control Figs, Cane, Bagasse, Juice, Filter Cake, Syrup etc. ... Table No. 21
- (c) Statement of Chemical Control Figs, Magma, Massequite, and Final Molasses ... Table No. 22

- (d) Statement of Chemical Control Figs. Milling Work, Sugar Made, Sucrose Losses, and Balances and Recoveries ... Table No. 23

12. Plant & Machinery Workshops

There are three main local plant and machinery manufacturers, having facilities of foundries, forging, fabrication and machining. A wide range of equipment such as mill rollers, cane carriers, juice heaters, evaporators, vacuum pans, crystallisers, pressure pipes etc. are locally manufactured. The locally manufactured items not only save foreign exchange of the country but are decidedly cheaper than the imported ones both due to higher labour cost and freight involved in the imported equipment. The items like Steam Turbines, Boilers, Centrifugal machines, Electric Generators are still imported through local agency firms. The main imports are from U. K. and to less extent from France, Germany and U.S.A., but due to high costs of equipment from these countries other Sources such as Japan, Australia, South Africa, Italy are being tapped. India is well placed to supply these items provided these are competitive and are satisfactorily backed by after-sale and maintenance services.

13.0 Acknowledgement

Before closing, the author wishes to record that the present paper is an outcome of his notes prepared by him during the assignment as Sugar Expert in Mauritius, observations taken, and survey done by him by visiting the various organisations and sugar factories as also study of the various documents published by the important organisations like: The Mauritius Sugar Producers Association, The Mauritius Chamber of Agriculture, The Mauritius Sugar Industry Research Institute, The Sugar Enquiry Commission and Action Plan prepared by the Mauritius Sugar Authority etc. Important data has been reproduced for the benefit of the subscribers and readers of Bharatiya Sugar.

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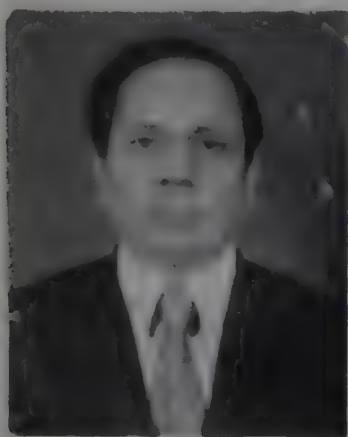
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PROCESS OF SUGAR MANUFACTURE IN INDIA REVIEW OF PROGRESS

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Introduction

Production of crystal sugar from cane juice has been practised in India since ancient times. However with the dawn of machine age the process of sugar making underwent a revolutionary change. It was in the mid-thirties that our modern sugar industry was established thanks to the protection granted to indigenous manufacturers. This period was followed by two decades of stagnation and from fifties onwards the industry has registered steady growth on sound lines wherein the modern trends in the industries of the developed countries were absorbed for enhancing efficiencies of operation.

It needs to be noted that notwithstanding the expansion and modernisation of the sugar industry in the past fifty years the basic process remains the same, as was developed in Java by the Dutch sugar technologists and adopted by our industry, viz. the 'plantation white sugar manufacture directly from sugarcane by either sulphitation or carbonation process'. Whereas in most of the developed and developing countries raw sugar is produced from cane juice employing minimum clarifying agents and is subsequently refined in large refineries, in India we are manufacturing direct consumption white crystal sugar of about 99.8% sucrose content from sugarcane. In the past two decades remarkable strides have been made in the direction of improving colour of sugar and producing large grain sugar. Through constant endeavour and adoption of new techniques the sugar technologists have achieved spectacular results in respect of efficiencies of operation and manufacture of sparkling white sugar comparable to the refined sugar produced in other countries.

Process

The sugar manufacturing process followed in India can be briefly divided into three major operations viz., crushing, clarification and crystallisation. In the first operation the sugarcane is first crushed and the juice extracted in milling tandem comprising four or six, three-roller mills, with application of warm water at the last mill or last mill and the penultimate mill. As an alternative to complete milling, milling-diffusion system is also practised in a few factories.

Whatever the system followed, the main object in this operation is maximum extraction of juice contained in the sugarcane processed.

In the second stage of the process the juice is subjected to treatment of heat, alkali and acid whereby the suspended impurities and some colloidal impurities are removed and juice rendered transparent and brilliant. There are three variants of the process followed.

While producing raw sugar mainly for export, the juice after heating is treated with lime and phosphate solution. In most of the factories whose sugar production accounts for nearly 85% total white sugar produced by vacuum pan process, lime, sulphur dioxide are used as clarificants. The calcium sulphite formed in situ settles carrying with it the impurities. In carbonation process lime, carbondioxide and sulphur dioxide are the clarifying agents employed. The clear juice from this operation is concentrated in a multiple effect evaporator such that the resulting syrup contains about 40% water. In the final stage of production, this water is removed in pans to the point of isolation of sugar-crystals in pans. The massecuite formed in pans are dropped in crystallisers and centrifuged. Normally three stages of boiling are resorted to for recovering maximum sucrose from sugarcane juices.

The aims of the technologists engaged in sugar industry over these years have been to (i) improve yields of sugar by reducing the losses, (ii) improve the quality of sugar produced in terms of its appearance and composition, (iii) reduce the dependance on human judgement for control of the process, (iv) reduce the cost of production by economising the use of chemicals and energy and (v) improving productivity of machinery units so as to increase the output and capacity. The modifications contemplated at various stages of operations have been mainly based on the above considerations and the industry has witnessed significant developments in the last three decades in respect of techniques of operation and the equipment installed.

Juice Extraction

1. Milling

In the first stage of the process of manufacture,

the sugarcane after being weighed, is crushed in mills for extraction of juice. In the old mills, the cane would pass through two sets of knives and fed to mills, with warm water of imbibition sprayed on the blanket of bagasse going to last mill. The mills used to have peripheral speed of 6-7 m. per minute, and were driven by slow speed steam engines.

1.2 In the last two decades or so preparation of sugarcane has received special attention in view of the influence of the same on final extraction and the capacity of the mill station. Although in a few factories shredders were installed in thirties and forties, with good results, by and large cane preparation was accomplished by two sets of knives. An important land mark in this field was the reversal of cutter knives (i.e. 2nd set of knives, the first being the leveller) first established by Krishnamurthy Chetty¹, which resulted in fine preparation of cane, though the power requirement increased. Later development related to the introduction of preparatory device combining the important features of shredder and knives, known as unigrator or fibrizer first developed by Ducasse². This has helped the preparation to be substantially improved, and has found wide acceptance for the excellent cane preparation index of cane indicative of the cells opened in the cane cutting and shredding is around 50-60 with two sets of knives and can be as high as 75-80 with fibrizer and slightly higher about 80-85 with shredder³. In respect of power requirement the shredder consumes much higher horse power as compared to two sets of knives, or fibrizer which replaces the cutter set, whereas the shredder is preceded by two sets of knives.

The equipment installed with a view to achieving high degree of preparation now usually consists of (a) cane leveller, (b) set of knives, (c) Shredder or cane leveller and fibrizer. The total HP. installed for preparation alone is around 55 to 65 per t. fibre per hour. Improvement in preparation index has led to enhancement of the capacity of the mills by 10-15% and increase in extraction by at least 1%.

2. Yet another area where spectacular results have been achieved is the water application at mills, known as imbibition. Compound imbibition system is in vogue since long but the amount was restricted to 120-150% of fibre in cane. Of late, following the foot steps of Australian millers, Indian technologists have started increasing the quantity of water to 200-250% fibre with excellent results with respect to extraction as well as recovery of sugar. In Tamilnadu the factories are working with high rates of imbibition exceeding 200% fibre⁴. Moreover the factories maintaining higher temperatures of water at 70°-75°C as against the normal practice of using 50°-55°C water have been able to record higher extraction (96.0) and lower moisture in final bagasse (47-48%).

3.1 Fine preparation and high rates of imbibition have necessitated installation of underfeed rollers for the mills as well as Donnelly chutes to facilitate gripping of sugarcane or cane feed by the mills.

3.2 All modern mills are turbine driven and run at a peripheral speed of 11 to 13 m. per minute. With the greater stress on employing high horse power for preparatory devices and fine preparation obtained, conceptual change in regard to capacities of mills has been witnessed in the last decade. The standard size mills of 760 x 1550 mm designed for a maximum crushing rate of 2000 t/day can handle upto 3200 t/day with good extraction. Arcing of rollers with special electrodes has become an established practice and has further helped increase crushing rate even at high rates of imbibition, as arcing improves gripping of fine and wet bagasse.

3.3 In Australia, for facilitating gripping of finely prepared cane, five roller mill was evolved. Another advantage with this design was that capacity of mill would increase without addition of mills, after all the mills are converted into five roller mills. Thus a tandem of four five roller mills would achieve the grinding rate of six mill tandem, besides ensuring higher extraction. A few factories in India are equipped with five roller mills⁵. A further innovation has been the development of toothed roller pressure feeding system wherein two feeding rollers of a mill provided with teeth instead of peripheral grooves⁶ are installed for each mill. This requires less power as compared to earlier five roller mill. In one factory in North India this system has already been introduced with success and in another factory in Maharashtra it is recently installed. Expansion of plant capacity can be achieved by converting the existing three roller mills into five roller mills, two feeding rollers being specially provided with teeth, while the bagasse passes to next mill through closed chute.

4. Automation of cane feed to mills has recently been installed in some mills with good results. Sensors are installed on the carrier which transmit signals to the cane carrier driving motors, the speed of which is regulated so as to maintain constant thickness of the cane blanket⁶. It is well known fact that the mills will work efficiently only if the feed is uniform, since uneven feed causes choking and also affects extraction. This innovation introduced in Louisiana over two decades back, has in recent years been adopted in many mills.

5. Diffusers

Only few factories have installed diffusers which in Indian industry could not be established perhaps due to technological failure associated with their operation. Diffusers admit of little flexibility in designed capacities unlike the mills and require uninterrupted operation. There are mainly three types of diffusers

which are bagasse type diffusers, i.e. their function starts after primary extraction is over, installed in Indian Industry.

5.1 In D.D.S. type diffuser first installed at Belapur, the bagasse after primary mills, is introduced in a 15 m. long S.S. trough and gets desugarised during its passage, while the sugar enriched juice is withdrawn from bagasse feed and thus ensuring thorough counter-current extraction. The exhausted bagasse is stripped of its thin juice (3.5-5 Bx) in two dewatering mills. This is immersion type diffuser in as much the entire bagasse passes through a bath of macerating fluid.

5.2 In yet another type, based on the principle of percolation viz. De Smet diffuser the bagasse after primary extraction is fed to a belt conveyor, and on its passage meets hot thin juice and finally water which are sprayed on the bagasse blanket in 13 stages. Counter current extraction principle is adopted in this extraction process, while the juices sprayed are limed for maintaining neutral condition.

5.3 In 'Saturn' diffuser installed in one factory the equipment design contains both immersion and percolation principles.

The diffusers have given excellent results with regard to extraction even at an imbibition rate of around 150% fibre^{7,8}, due mainly to positive and intimate contact of imbibition fluid with bagasse. Diffusers are continuous operating machines and precise conditions have to be maintained with respect to different parameters like pH, temperature, retention time, and give very good extraction, when run at optimum capacities, but give rise to high non-sugar extraction and decomposition of sucrose if the optimum parameters are not adhered to. They are low power consuming in that a bagasse diffuser can be deemed to perform the function of three mills. For various reasons diffusers did not find favour with Industry.

Clarification

1 There are certain fundamental reactions which have to be taken into account while considering the merits of any clarification process, which are given below :

- (i) Sucrose and reducing sugars have to be retained intact, in that their decomposition leads to higher sugar loss in process. As is well known reducing sugars help in improving exhaustibility of molasses.
- (ii) Sucrose is sensitive to acidic condition and at pH lower than 7.0 under influence of heat undergoes decomposition, while it is stable under high pH conditions.
- (iii) Reducing sugars under influence of alkali are transformed into organic acids like lactic acid which forms soluble calcium salts. High tempera-

tures accelerate this reaction.

- (iv) Maximum elimination of non-sugars is aimed at in clarification and the chemicals employed are mainly lime, super phosphate or phosphoric acid and sulphur dioxide in the defecation and sulphitation process. In carbonation mainly lime and carbon dioxide are used and the excess alkalinity is neutralised by sulphur dioxide.
- (v) Soluble lime salts formed on account of reaction with organic acids either originally present or formed during process, not only give rise to scaling of heating surfaces of evaporator but also lead to higher molasses formation.
- (vi) Defecation is based on formation of tricalcium phosphate in situ while sulphitation involves generation of calcium sulphite. In carbonation calcium carbonate is formed. Thus formation of insoluble calcium salts is the basic principle governing the different process of cane juice clarification.
- (vii) In sulphitation process, with juices deficient in P_2O_5 as in Deccan, external addition of soluble phosphates or phosphoric acid is necessary to the extent of 100-150 mgm/litre to obtain satisfactory clarification.

2 Chemicals used

2.1 Lime is either purchased by the factories from manufacturers or produced in continuous lime kilns by burning lime stone employing coal in fuel. Burning lime stone at factory site is advantageous from the point of view of maintaining proper quality of lime in as much as fresh lime is available always and deterioration in storage is obviated and is practised by a number of sugar mills, despite the high cost of the transport of lime stone and coal. Lime (CaO) in the form of lumps is slaked in condensates to form $Ca(OH)_2$ or milk of lime in continuous rotary slakers which have replaced in the past three decades the old batch type slaking tanks. Degritting of lime is an important aspect of preparation of good quality milk of lime and thorough degritting is accomplished either in hydrocyclone or 'Dorrclone'⁹ in some factories. In many plants however screening of slaked lime is common. Undoubtedly thorough desanding and degritting helps in reducing wear of valves, pumps, and pipes and tanks etc. through which lime and treated juices pass.

2.2 Sulphur dioxide is generated in stoves or burners which though designed for continuous operation are incapable of giving uninterrupted supply of SO_2 gas of uniform composition in most of the factories. Continuous operation essentially involves feeding molten sulphur continuously to the burner so as to maintain constant level in the burner. However in the present designs this is seldom achieved on account of leaking

valves or non-uniform combustion etc. with the result that once in two or three hours, while charging the burner the air supply is cut off for a minute or so, which interrupts SO_2 gas supply to continuous juice sulphitation system and is thus undesirable. Moreover sometimes sublimation of sulphur takes place causing choking of SO_2 pipes, valves etc. and eventually mill stoppage. This sublimation problem has now been overcome by providing combustion chamber after burner, with secondary air supply for ensuring complete conversion of sulphur to sulphur-dioxide.

The equipment for generation of sulphur dioxide comprises (a) Sulphur melter, (b) Hopper, (c) Stove or burner, (d) combustion chamber, (e) Water cooler. The feed consists of either powder or lump sulphur of about 99.5 to 99.9 purity and the objective is to obtain sulphur dioxide of more or less uniform composition, air being fed from compressor continuously. Complete automation of this system which is of vital importance, is to be based on (a) temperatures of SO_2 gas generated and molten sulphur, (b) continuous feed of sulphur melt and air.

Attempts are being made by one manufacturing firm to regulate the working of sulphur burner on the basis of above parameters and a few units are installed already. CEERI is also engaged in developing micro-processor based control system for sulphur stores, aimed at regulation of sulphur dioxide gas of uniform composition¹⁰.

3.3 As regards phosphates, triple superphosphate of 45% P_2O_5 is being used for many years in the sugar factories but in the past few years phosphoric acid containing about 80% P_2O_5 has been found to be more effective as it is free from other salts unlike the super phosphates. Whereas the superphosphate made into a slurry in hot condensate contains lot of insoluble matter which is allowed to settle and thrown out, the phosphoric acid needs only dilution to the desired extent, being free from insoluble matter. Many factories have experienced better results in clarification by using phosphoric acid in place of T.S.P.¹¹

3.4 Other chemicals

Dicalcium phosphate dissolved in sulphurous acid was used at Ravalgaon¹² with good results. This phosphate contains about 40% P_2O_5 and is insoluble in water but dissolves in sulphurous acid. Ammonium phosphate or diammonium phosphate was used and is claimed to reduce CaO content in clear juice. However its use is not recommended as the ammonia evolved in evaporator damages the brass tubes as reported by the author in his detailed studies on use of various types of phosphates in clarification¹³.

Magnesium hydroxide in partial replacement of the lime reduce scale formation but large scale

trials at various places like Sakharwadi have shown that the clarified juices are hazy in appearance, which can have deleterious effect on final sugar¹⁴.

3.5 Settling aids

Since three decades in Maharashtra region, some factories have been experiencing serious problem of high mud volume in clarifier as settling of sulphited juices gets retarded resulting in reduced crushing rates particularly during periods when cane is reaching maturity and the sugar recovery starts rising. In the early sixties this problem had assumed serious magnitude and the technologists could not solve this difficulty with the conventional methods of dilution of juices or varying the lime doses and temperatures. Separan AP30, a high molecular weight polymer, developed in U.S.A. was introduced at this stage and was found very effective in improving settling rates. Studies on the problem of settling carried out at Yeshwant factory in Maharashtra are reported by the author¹⁷. Subsequently more such chemicals were introduced like Sedipur TF_2 which is also found very useful in improving settling of mud. Recently new chemicals like Magnafloc 26 and 27 are becoming popular. Some indigenously developed chemicals as settling aids are also being used by some sugar mills. Development of single tray clarifier referred to later, should be accompanied by production of indigenously developed effective settling aids, as the ultimate objective in the settling of treated juices should be to achieve faster settling and minimum residence of juice in clarifier of 1/2 hr. to 45 min. as against 4 hours obtaining at present.

Surfactants

Some surface active agents, particularly the cationic type, are expected to precipitate the colloidal matter in cane juice and good amount of experimental work was carried out at the N.S.I. by Ramaiah et al on this aspect, employing cetylpyridinium bromide or 'Fixanol C' with juice limed to 7.0 pH. The pilot plant results were encouraging¹⁸. The author recently conducted some experiments on the use of indigenously developed surface active chemicals in conjunction with juice defecation and sulphitation. Experiments were also conducted on syrup. The treatment of surfactant does give higher rise in purity (1-2 units) and brilliant juice, colour being reduced by 25-30% over the normal treatment. However the cost of surfactants is prohibitive for use on such large scale. More work is required to be carried out in this field.

4 Equipment

4.1 The old batch sulphitation tanks gave place to continuous sulphitation vessels of different designs, nearly twenty-five years back. While the SO_2 gas is continuously blown from below, the lime is continuously fed from top in the desired proportion through a proportioning device. The exhaust gas from the reaction tank

is passed through a tower with baffles, which meets the incoming raw juice. With regular flow of juice and SO_2 gas the treatment is fairly uniform. The treatment tanks are usually equipped with stirers, and baffles to prevent short circuiting, however in some cases stirers are dispersed with and the circulation is sought to be achieved by the action of upward gas flow, juice flow and baffles.

The main treatment vessel is connected to a reaction tank equipped with stirrer to ensure completion of chemical reactions. The total retention time of juice in the system is 10-15 minutes. A number of equipment designs have been developed for this station, broadly conforming to the above pattern. Irrespective of the make of the equipment, the design must take into account (a) thorough contact of the reactants with juice, (b) no formation of dead pockets or short circulating of either juice or acid or alkali, (c) total retention time of 10-15 minutes, (d) facility for either preliming and/or presulphitation, (e) no disturbance of the precipitate flocs formed.

4.2 Juice Heaters

Tubular multipass heaters are quite common, the heating medium being in most of the factories, vapours from 2nd or 1st body of evaporator for raw juice heating to $70-75^\circ\text{C}$ and vapours from vapour cell or first body of evaporator as well as exhaust steam for final juice heating upto $100-102^\circ\text{C}$. Recently some factories have introduced use of Aluminium tubes in replacement of the brass tubes, the former being much cheaper than the latter¹⁵. Yet another innovation in juice heating has been the installation of direct contact juice heater, which is similar in construction to a barometric condenser, wherein vapours from 2nd or 3rd bodies of evaporator are directly mixed with juice, heating and diluting the same to some extent¹⁶. It is considered that direct contact juice heating would be ideal for heating treated juice as the flocs would not get disturbed but the heating medium will have to be high temperature vapours ($103-105^\circ$) from vapour cell. Equipment for direct contact juice heating is much cheaper than the conventional multipass tubular juice heaters and the entire system of direct vapour heating needs to be properly developed and designed taking into account (a) the real steam economy achieved in view of extra load of evaporation that dilution entails, (b) need to automatically regulate temperature of juice, (c) avoidance of local overheating and thorough contact of juice with vapours.

4.3 Settling and filtration

Continuous settlers were introduced in Indian Industry in late thirties and have not undergone major design changes except that in some designs the mud settling area has been increased and multiple mud

withdrawal offtake provided. All the standard settlers provide 3.5 - 4 hours retention time of hot juice of about 100°C which is certainly undesirable.

Single tray clarifier developed in Australia¹⁹ which reduces the juice retention time to 15 min. is being increasingly adopted in that industry. It needs however, continuous addition of settling aids to the feed. The salient features of this settler are a peripheral withdrawal of clear juice by even distribution of feed in an area where particles settling are not disturbed. Adaptation of this type of clarifier for sulphitation process has been reported from Indonesia²⁰. In India also attempts have been made to install small single tray clarifiers. But vigorous efforts and experimentation are called for in establishing this design in view of the low retention time which would avoid sucrose destruction taking place with longer retention time.

Taking cue from the design details of this new clarifier, Indian technologists have fitted multiple clean juice offtake devices consisting of circular pipes with a number of perforations, on the periphery of each chamber of the present four chamber clarifiers with distinct advantages and good results.

The present filters eliminate only part of the mud from the settled portion of the treated juice from the clarifier, as the filtrates contain about 40% of mud, which is circulated in the clarification system. The filters work continuously and the loss in filtercake is very low, but the recirculation of mud in clarification is a disadvantage which has so far not been tackled effectively. Separate treatment of filtrates has been suggested, but not yet adopted on big scale. Experiments were conducted on use of different filters like D.D.S. thickening filter without success²¹.

5 Controls

The most important parameters to be controlled in sulphitation for achieving desired results in respect of (a) elimination of non-sugars, (b) avoiding decomposition of sugars, (c) good clarity of juice and (d) rapid settling of muds, are (i) pH (ii) desired quantities of dose of chemicals in proportion to juice and (iii) temperatures. The pH of the treated juice was till recently controlled by the indicator method and B.T.B. papers. Of late electrometric pH measurement and control of pH on the basis of sensors installed at the exist of treated juice and regulation of lime dose, have become common. Of the many systems installed, the one developed by Central Electronic Research Institute, Pilani in which the pH electrodes are dipped in flow of cooled treated juice for prevention of fouling of glass electrode, has received acclamation as the best and is adopted in a number of sugar mills. Needless to state that the pH measurement is based on glass-calomel electrode system. Thus so far we have succeeded

in automatic regulation of lime dose on the basis of pH of treated juice.

The present pH control system suffers from three inadequacies :

- (a) only lime dose is controlled to maintain pH of 7.2 - 7.3 which in turn means that the lime quantity may or may not be adequate for each and every portion of juice.
- (b) SO_2 gas flow is uncontrolled and variations in either quantity of gas per unit time or the percentage of SO_2 in the gas generated by the burners are taken care of by the lime. There is thus every possibility of uneven generation of calcium sulphite precipitate from time to time.
- (c) The ratio of lime dose to juice has in fact to be determined by the technologists for particular type of juice for obtaining the desired effects of good clarification. Thus the flow of lime has to be strictly in proportion to the juice flow and has to be maintained constant in accordance with the requirements of efficient sulphitation.

In the context of above, the present pH control system falls far short of the requirements as what we need is :

- (a) maintenance of constant ratio of lime to juice.
- (b) regulation of SO_2 injection in juice tank to maintain the desired final pH and neutralise the lime.

This calls for perfect control at the sulphur burner so as to ensure more or less constant SO_2 content of gas and variations in gas supply to suit the lime dose and final maintenance of pH. This in turn would involve development of suitable SO_2 generation system with flexibility of gas generation which would be amenable to automatic control.

Of equal importance is the proportioning of lime flow to the juice flow, in which rate of lime flow will be linked to the rate of juice flow and will involve installation of juice flow meters. This is long overdue and needs to be developed properly, as early as possible to enable foolproof system of clarification control to be evolved.

Addition of phosphate solution, either in the form of dilute phosphoric acid or extract of triple superphosphate at the raw juice stage is regularly practised in Deccan and some sugar mills in South, the method of addition being either manual or by allowing continuous flow of phosphate solution into raw juice receiving tank. This needs to be automated so that the dose of phosphate is in proportion to the juice. Stray attempts have been reported about automatic proportioning of phosphate solution to juice quantity by feeding predetermined phosphate dose to juice after each tipping of raw juice scale²².

Maintenance of juice temperature is usually manual operation and poses little problems in a continuously running factory. Nevertheless automatic temperature controllers which would regulate the flow of vapour or steam would help maintain precise temperature of juices.

5.1 Effects of Sulphitation

The sucrose purity rise indicative of the non-sugar elimination varies from zero to one unit, in some cases being negative. The colour changes studied by the author indicate reduction in colour from mixed juice by 29%²³. Similarly the increase in CaO content from raw juice to clear juice is about 20-30%, while elimination of colloids upto around 30-45% is achieved. These changes in the condition of juice on sulphitation, by no means fulfill the desired goals of clarification and thus the process offers wide scope for improvement.

Sometimes changes in juice composition arising out of the variations in quality of cane cause serious difficulties in operating this process. One such problem of difficult settling of muds has already been discussed earlier. Sharma observed high colour development and high mud volume problem and ascribed it to high polyphenol content of juice²⁴. Similarly cane variety Co 1148 gave lot of trouble in the north both from the point of view of colour and settling, which could be overcome by using heavy dose of lime. The sulphitation process is undoubtedly sensitive to changes in composition of juice and the technologists have to conduct frequent experiments to determine the optimum doses of lime as well as phosphate besides determining whether prelimining or presulphitation offers advantages.

5.2 Carbonation

Carbonation process of clarification was developed in Java much earlier than the sulphitation, and employs ten times the quantity of lime compared to the latter. The lime is necessarily produced at the factory site in a continuous closed lime kiln, from which the CO_2 evolved in limestone burning is collected and used for neutralisation of lime in process. Colloids, colouring matter and some inorganic components of the raw juice are precipitated at 10.5 pH and eliminated by two stage filtration at pH of 10.5 and 8.5. Thus unlike sulphitation, carbonation is essentially a treatment at high pH and low temperatures. The special features of carbonation process as distinct from the sulphitation are :

- (a) higher sucrose purity rise 3-4 units.
- (b) very high lime consumption but low sulphur consumption.
- (c) destruction of reducing sugars to the extent of 25-30%.
- (d) filtration of entire juice.
- (e) production of superior grade sparkling white sugar

which on keeping may develop colour, imparting yellow tinge to crystals.

- (f) reduction of molasses quantity due to elimination of nonsugars as also reduction in viscosity of final massecuites.

The standard carbonation process incorporates three stages, first in which juice of 55°C is limed to pH 10.5 and CO₂ blown in to maintain alkalinity equivalent of 300-800 mgm/ltr. followed by filtration of the juice. The filtered juice is again treated with CO₂ to 8.2-8.4 pH, heated to 70°C and filtered again. This alkaline filtrate is sulphited to neutrality in the last stage. Considerable work of practical importance has been reported in improving the operational character of this process in the past three decades.

The carbonation process has been conducted mostly in batch operations, at the treatment and filtration stages. Mishra replaced the batch carbonation reactors with new design of carbonator and introduced low pressure filtration (1 kg/cm²) with good results at Kiccha and Rohana Kalan factories of north India²⁵. Settler and filter of Dorr Oliver Co. installed in Daurala converted the batch filtration in filter process into a continuous operation²⁶. The results of trials with Dorr thickener and cloth coated vacuum filter at that factory were encouraging, S. C. Sharma and K. S. Saksena conducted studies on the relative merits of continuous first carbonation and batch operation and concluded that the results of the former were inferior to those from conventional batch system, being non-uniform and inconsistent as regards settling characteristics, reducing sugar destruction and filterability²⁷.

As regards second carbonation successful trials with G. P. filter at Ramkola for filtration of second carbonation juice are reported by N. K. Sawney, who obtained apart from well controlled continuous operation, reduction of sugar loss in cake and good clarity of filtered juice²⁸. In sulphitation of second carbonation filtered juice Quorez System, wherein the SO₂ is mixed with juice by aspiration was employed for the first time in India in Nagaland with beneficial results²⁹.

Middle juice carbonation wherein the prelimed hot raw juice is concentrated to about 350bx and subjected to carbonation in the usual way has been reported to yield almost the same clarification effects in respect of purity rise and reducing sugar decomposition, but however has shown benefits in the form of reduced limestone and coke consumption by 23-25% as also removal of sulphates at one of the factories of Cawnpur Sugar Works³⁰.

As early as in 1960 Saha³¹ conducted some experiments in laboratory and found neutralisation of clear juice from second carbonation filtrates by triple superphosphate instead of SO₂ gives good results, as regards

reduction in CaO, colour, nonsugar removal etc. Sang³² reported in 1971 ISSCT, results of working of similar process in Taiwan i.e. phosphatation involving yet another stage of filtration, which is not called for in the conventional sulphitation. The process adopted at Kiccha, while incorporating the above principle, however, deviates from the Taiwan process in that the unfiltered second carbonated juice at 70°C is treated with phosphoric acid and sent to subsider for continuous withdrawal of clear juice. Marked improvement in colour of white sugar are reported from Kiccha by this process³³.

causes problems in our process.

5.4 New Techniques

This process of clarification developed by Saha at the Indian Institute of Sugar Technology, Kanpur, incorporates the principle of alkaline filtration of sulphited juice at 10.5 pH for better elimination of colloids and inorganic components^{34,37}. In this process the juice heated to 70° was limed and sulphited and boiled to 100°C as in the conventional process, using normal requisite dose of lime. The boiled juice was subsequently limed to pH 10.5 and filtered, the alkaline filtrates being neutralised by triple superphosphate or sulphur dioxide and filtered or sent to subsidisers. The resulting clear juice gave a sucrose purity rise of 2 to 4 units and was sparkling in appearance, comparable to that from carbonation process. In subsequent modification the author of the process, tried to neutralise the alkaline juice partly by sulphur dioxide and partly by superphosphate. Thanks to the generosity of the sugar industry, the process was given fair trial at Ravalgaon, Ugar and Sakarwadi in Maharashtra as well as three factories in U. P. and Bihar. The sugar produced though initially sparkling white comparable to that from carbonation process, later developed brown tinge on keeping. The process did not succeed on account of :

- (i) Problem in alkaline filtration, as the cloth used to get stiff after each filtration, bringing down rate of filtration.
- (ii) Reducing sugar destruction.
- (iii) Development of colour in sugar.
- (iv) Low purity rise on large scale trials of 1-2 units.
- (v) Very low improvement in boiling house extraction.
- (vi) Heavy scale formation in evaporator and pans.

The stiffening of filter cloth due to pores being clogged by impurities was sought to be tackled by treating the cloth with mild hydrochloric acid solution at high temperature.

These two processes, though abandoned for various reasons discussed earlier, however, can be considered

to be landmark in the technological progress of the sugar manufacture in that valuable research work was conducted on various aspects of juice clarification and important findings have been reported. The industry's willingness to give fair trials to innovations in technological fields was also evident in this connection. As in every scientific endeavour hereto, efforts were not wasted, in as much as new knowledge and insight into the treatment of juice were gained as a result of the research work connected with these processes.

It must be pointed out however that with all its beneficial aspects relating to removal of non-sugars, production of good quality sugar and enhanced boiling house extraction, widespread adoption of carbonation is not possible on account of the huge quantities of lime requirement (ten times that of sulphitation process), cumbersome operations and finally too much dependence on human element arising out of lack of automation and continuous working. Moreover the sulphitation mills, by remelting of low grade sugars and boiling first massecuites in high purity medium have been able to produce excellent quality of sugar in the last three decades.

5.3 Electrical Process

Ghosh developed the electrical process of clarification employing iron electrodes in 1946, which was given a fair trial at the experimental sugar factory of the National Sugar Institute from 1951 to 1955^{34,35}. In brief the original process consists of electrolysis of cane juice heated to 80°C until pH increased from 5.2 to 7.2. The juice with the precipitate was filtered and the filtrates treated with triple superphosphate solution to pH 6.8 and subsequently filtered again after boiling. Thus this process seeks to eliminate the conventional use of lime and sulphur dioxide. According to Ghosh's theory, the ferrous ions, generated according to Faraday's laws of electrolysis combine with anions with the formation of iron salts. The resulting juice gave a sucrose purity rise of 0.8 unit, but contained about 10 mgm. of iron in 100 gms. of juice. Even though the juice was good in respect of clarity the sugar produced therefore contained high amount of iron which imparted dark appearance to the same. Moreover the reducing sugars were decomposed to the extent of 29-30%. Subsequently the inventor of the process modified the process by first neutralising the juice to be electrolysed by lime to pH 6.8, with the result that iron content of clear juice was reduced to 0.33 mg/ltr. of juice. To reduce the cost of electricity and iron, further modifications were tried out by the staff of N.S.I. and Ghosh but the entire scheme floundered for following reasons :

- (a) Costs of power consumption are high and the electrolysis is uneconomical.
- (b) Generation of foam as a result of evaluation of

O₂ and H₂ during electrolysis, causes loss of sugar

- (c) Filtration is not easy in the first stage.
- (d) Rise in purity during clarification was low 0.5 - 1 unit
- (e) In subsequent modifications, lime and sulphur dioxide were introduced with a view to reduction in costs and overcoming the problems regarding high iron in clear juice etc. which defeated the main purpose of the original process of avoiding the use of imported sulphur and also lime which

6. Evaporator

6.1 As stated earlier this station removes water from the juice to the extent of 70-75% and owes its importance to its vital role in the energy consumption in the entire process, in as much as design of this station is a vital link in the chain of steam saving devices installed in the factory. Most of the work done by the technologists in the area of energy conservation relates to use of maximum amount of vapours from different bodies in place of steam, problems of scale formation on heating surface and incorporation of new designs.

Despite persistent efforts to bring about greater steam economy in process operation in the past three decades, and the spectacular results achieved, much more can be done in this area and the technologists are alive to the needs of the industry in respect of conservation of energy. In keeping with this trend the factories have adopted 90-100% juice heating by vapour and 20-100% boiling of pans on vapours from vapour cell or pre-evaporator which forms an essential part of the modern evaporator station, the main principle being to allow minimum vapour to go to condensers and generate maximum vapours from earlier bodies of evaporator for heating and boiling. New design of pre-evaporator fitted with long tubes popularly known as semi Kestner vapour cell has been installed at a number of factories the vapours of about 105°C being employed for vapour boiling³⁸. Apart from this, vapour cells of conventional design for the same purpose have also come into vogue, with good results in respect of steam economy. Preheating of clear juice from 95° to 105°C assists the maximum utilisation of heating surface of vapour cells for evaporation and enhances rate of evaporation. Plate type heat exchangers which occupy less space and are highly efficient have been installed for preheating of clear juice before its entry into pre-evaporator, in a number of installations.

6.2 As regards the construction of equipment Aluminium tubes have replaced the conventional brass tubes in the vapour cells of some factories³⁹. They have been introduced even in juice heaters and pans with satisfactory results. Aluminium tubes are very cheap compared to brass tubes, but cannot be cleaned by caustic soda boiling for fear of chemical reaction between alkali and aluminium. In practice heat transfer rate is

unaffected by substitution of Aluminium tubes for brass tubes in the calandrias of evaporator. Various designs of evaporator bodies basically incorporating the principles of uniform distribution of heating medium in the calandria, high rate of heat transmission and uniform operating conditions, have been introduced by the machinery manufacturers and the technologists have in many instances contributed to the efficiencies by installing small devices and bringing about improvements in the evaporator.

6.3 Scaling of evaporator heating surface has been serious problem in Deccan with the juices containing high CaO, forcing the factories to shut down once in two weeks or so for descaling work. The deposition of calcium salts can be prevented to some extent by adding phosphoric acid to the clear juice which increases the solubility of calcium salts⁴⁰. As regards removal of scale, high brix caustic soda solution (30°-40°Bx) containing washing soda etc. under atmospheric pressure has been found to detach the scale from tubes and render removal of the same easy. For acid boiling of the vapour cell and first body of evaporator, use of special inhibitor has become quite common. Fluorides are also added to soda solution or acid for dissolving salts of silica.

6.4 Attempts are being made to ensure uniform operation and high efficiency by introducing some sort of controls. The system of complete automation of evaporator, based on the desired degree of concentration though complex, is feasible, and is under trial at a few factories. This calls for a buffer tank of clear juice, steady steam and vacuum conditions and smooth flow of material. Very likely such system would be developed indigenously in the next few years⁴¹.

6.5 Syrup Sulphitation

Sulphitation of syrup to pH 5.0 or so is now practised in continuous systems. But the system would become foolproof if controlled and continuous supply of SO₂ gas is ensured. We have yet to design and perfect sulphur dioxide generation which will supply regulated quantities of SO₂ gas whereby automatic pH control of sulphitation would become feasible. It is high time that full automation is introduced in syrup as well as juice sulphitation, with controlled and continuous operations of sulphur burners.

7. Sugar boiling and crystallisation

7.1 It is at the panboiling stage that sugar crystal makes its appearance felt, and around 50-70% of the total sugar loss is in process of cane sugar manufacture, are caused. Pan boiling, decades back was considered an art, an exclusive preserve of few skilled workmen; however with modern techniques developed in the past three decades, it is being transformed into science. Whatever the other processes may be at juice extraction

stage or clarification stage the way to maximising sugar yield, which is the main objective at this station, is to crystallise out sugar in three or four stages and throw out non-sugars in the form of final molasses. In this context the main aspects of the technological innovations are confined to equipment designs, modifications in techniques and methods of scientific control including automation.

7.2 In the equipment design of vacuum pans, greater attention has been paid to achieving higher rate of evaporation, circulation of mass and thorough mixing of the material fed with the boiling massecuite leaving no dead pockets. The old coil type pans installed in the early stages of the industry gave way to calandria pans and subsequently to low head pans with a high ratio of heating surface to cubical content of the massecuite (6.5 m²/m³). Mechanical circulators have been installed in a number of plants for low grade boiling with beneficial effects on rate of boiling which is reflected in the total time taken for completing a pan strike. These however serve as aids for better circulation, in cases where it is not upto the mark for A and B strikes but are not very effective for pans with high heating surface to volume ratio and good circulation characteristics. None the less mechanical circulators are certainly helpful in final massecuite boiling. Two speed circulators have been developed, the lower speed to running being suitable for higher levels. Stationary louvers are fitted to many pans, which though not as effective as the mechanical circulators, by guiding the flow of mass in the pans improve circulation. It needs to be emphasised that high rate of circulation is of utmost importance from the point of view of uniform development of grain and reducing the time of boiling, which indirectly reduces caramel formation in pans.

Yet another step towards progress in pan boiling has been the conditioning of A heavy molasses, B heavy molasses and C light molasses, which was formerly accomplished by steam heating in tanks of 2-1/2 m. height, the steam coil being fitted at the bottom, and adding water from top. This faulty system has now been replaced by various devices, designed to ensure thorough mixing of steam and water with the molasses, without chances of local overheating and ceramel formation resulting therefrom. Molasses conditioners have become quite common in modern plants now a days⁴².

An altogether different design of pan, incorporating the main feature of 'Segura' type calandria with central steam feeding for the calandria, was developed some years back^{42a}.

Some attempts have been made in India to develop continuous pan boiling, which has been well established

in beet sugar industry of Europe and in sugar refineries. It is high time that the reputed sugar machinery manufacturers design this system indigenously in the interest of industrial progress, as early as possible.

7.3 As regards the process operation, grain formation in pans for 'C' massecuites which was mostly dependent on pan boiler's judgement and skill has been given up in favour of seeding. Fine grain seed is prepared either by grinding fine sugar in isopropyl ethyl alcohol or by grinding the fine sugar precipitated from the sugar saturated solution of sugar by adding ethanol. The final seed thus prepared is fed in the form of slurry, the medium being ethanol, isopropanol or any water in soluble solvent of low boiling point.

Control of Boiling

Automation at pan station has been a long felt need, in order to maximise capacity utilisation and for reducing sugar loss. Full scale automation is already adopted at two factories in Indian Sugar Industry for final massecuite boiling employing the control equipment of Polish and D.D.S. Make⁴³. Automation of feed control based on signals from modern conductivity instruments is already in operation in few factories. Central Electronic Engineering Research Institute has developed system indigenously for control of feed to pans, after perfecting design of conductivity meter wherein resistivity indicates the concentration of the boiling mass⁴⁴. However full control of pan boiling can be ensured only if the number of variables like vacuum, steam or vapour pressure etc. are kept more or less steady. Continuous panboiling would be easily amenable to automatic controls and the next decade will witness continuous and automatic system in operation at panboiling system.

Viscosity in Boiling

With increase in concentration in final massecuite boiling the mother liquor becomes progressively viscous. Since the high viscosity hampers proper circulation, deposition of sugar on the grains, presents difficulties, with consequent adverse effect on the exhaustion of molasses in final boiling stage. Chemicals have been developed which when added to final massecuite reduce the viscosity and help exhaustion of molasses. Viscosity increases with nonsugar concentration in the mother liquor and previously massecuites of 60-62 purity were dropped to facilitate handling the massecuite in centrifugal machines. With the advent of continuous centrifugals of new designs, the nonsugar recirculation has been checked and it is now possible to drop 'C' massecuites of about 55 purity, with consequent reduction in final molasses purity⁴⁵. C massecuite boiling has received considerable attention of the sugar technologists, as it has vital bearing on the loss of sugar in molasses and modern seed-slurry method, coupled

with the viscosity aid, and proper conditioning of A heavy B heavy and C light molasses have helped proper tightening of massecuites in the pans. Continuous centrifugals and transient heating of cooled 'C' massecuites have contributed to lowering of C massecuites purities and ultimately final molasses purities. Continuous cooling of C massecuites has in no small measure helped in this endeavour.

7. Crystallisers

7.1 Batch type crystallisers fitted with ordinary steering arms, for storage of the massecuite dropped from pans, are still universal for A&B massecuites. However for 'C' massecuites the crystallisers are provided with pipe or disc type stirring elements through which water of controlled temperature is circulated for cooling of 'C' massecuites from 65°C to 40°C. In some factories 'B' massecuites and even 'A' massecuites are cooled in water cooled crystallisers, good exhaustion being achieved in the cooling process⁴⁶.

7.2 In many factories the existing water cooled crystallisers are joined together so as to allow 'C' massecuites to flow by gravity from one vessel of the battery to the last one, being subjected to gradual cooling during its passage. This system has also been adopted for 'B' and 'A' massecuite cooling. In this system, the pan is dropped in a receiver crystalliser, from which the massecuite flows by gravity to the first vessel of the continuous system. In case of the receiver being located on the ground floor massecuite is pumped into the system. The cooling heat exchange elements have however to be leakproof, and some factories have faced the difficulty of revolving cooling coils developing leaks very often due probably to stresses developed during movement at the viscous mass offering considerable resistance. To obviate this trouble, at author's instance, stationary cooling coils with ordinary stirring elements were installed at one factory in the continuous cooling system for C massecuites with good results. Similar type of equipment has been in operation in continuous crystallisers for C massecuites in some factories.

7.3 Continuous vertical crystalliser for C massecuite cooling and reheating developed in India, represents a new trend at this station^{47, 48}. This crystalliser, 8 to 10 m. in height composed of two similar vessels or one vessel, is provided with stationary heat exchange elements and stirrers to keep the mass in motion. The massecuite gets progressively cooled and is reheated at the end before discharge. In all continuous crystallisers the flow of water runs counter to the flow of massecuite and the counter current flow of cooling fluid as also the material to be cooled ensures smooth and gradual heat transfer avoiding false grain formation arising out of sudden increase in super saturation.

Reheating of 'C' massecuites after the same cooled to 40-45°C for reducing viscosity is accomplished in batch crystallisers by circulating hot water 55°C - 60°C through the revolving heat exchangers. Some designs of 'C' massecuite pugmills, large heating surface is provided for the reheating coil with the area of reheating the massecuite. However careful investigations have revealed redissolution of sugar during reheating in systems involving revolving coil elements, resulting in rise in purity of 1-2 units.

Dr. K. S. G. Doss conceived for the first time in India idea of reheating cooled 'C' massecuites by passing A. C. which was put into practice in a few sugar mills. This system however involves high electricity consumption and is complex in design⁴⁹, but gave good results as no revolving heat exchangers were fitted in the heating units. Subsequently Dr. Doss developed transient heater wherein the cooled massecuite is made to flow by gravity over banks of stationary coils, through which hot water of 55-60°C is circulated. Since this reheating system causes no redissolution of sugar crystals it helps bring down molasses purity, and is installed in a number of factories⁴⁹.

8. Centrifugals

8.1 High capacity centrifugals running at high speed and equipped with automatic devices for different operations such as speed changes, water and steam wash marked an important hallmark in the march of progress in sugar manufacture in the fifties in as much as they not only reduced the number of machines but also ensured maximum separation of mother liquor from the sugar crystals as also controlled operation and less dependence on human judgement. Further advance in the modernisation was achieved when in the last decade these semiautomatic machines which involved some manual operations like plowing and starting were converted into completely recycling fully automatic centrifugals. Now-a-days, the modern factories install such fully automatic recycling centrifugals with high gravity factor (exceeding 900 g) for 'A' & 'B' curing. Centrifugals with steep cone, baskets, do not need plowing as the sugar is discharged as soon as the machine comes to a halt and are suitable for 'A' and 'B' massecuite curing. The flat bottom basket machines are necessarily equipped with hand operated mechanical plow or completely automatic plowing mechanism and can work for any grade of massecuite.

8.2 Washing sugar in centrifugals and further drying it are achieved by spray of hot water and steam at 5-6 kg/cm² pressure. This system is usually associated with steep cone basket machines. These two operations however are performed by use of superheated water of about 120°C and 4-5 kg/cm² pressure in flat bottom

centrifugals with high gravity factor. With centrifugals equipped with steam drying the sugar is dropped at high temperatures 50°C-60°C and has to be cooled in grasshoppers so as to achieve final bagging temperature of 40°C. This cooling is however seldom achieved. With superheated wash water system the temperature of sugar discharged from machines is around 45°C which is lowered to 36-38°C on grasshoppers.

Continuous centrifuging of low grade massecuites developed in fifties was introduced in Indian Sugar Industry about 25 years back⁵⁰. Initially horizontal centrifugals were installed but have now been completely replaced by vertical basket machines. Based on thin layer separation, the massecuite feed in these conical machines as also the sugar discharge are brought about from top, the discharge of sugar taking place from sides, while the feed is arranged at the centre or slightly off centre of the bottom, in different designs. The continuous centrifuging has been a very important hallmark of modernisation in the world sugar industry and improved designs of continuous machines are ideally suited for 'C' massecuite curing in view of the thorough separation of molasses giving high pol of sugar of 85% or so as against 75-80% obtained even with high gravity batch centrifugals, thereby reducing recirculation of nonsugars and reduction of sugar loss in molasses. The only disadvantage of these centrifugals is the crystal erosion and damage to crystals due to impact, which comes in the way of the sugar from these machines being used as seed for boiling high grade massecuites. Some manufacturers have incorporated instant steam heating of 'C' massecuite at the time of feeding either by opening steam at the point of feed or by introducing steam in the feed pipe of machines. Heating of 'C' massecuite helps better separation of molasses by reducing the viscosity and instant heating precludes redissolution of sugar.

8.3 Reduction of viscosity of 'C' massecuites before centrifuging assumes special significance in the context of achieving the best results from continuous centrifugals and ideal way is to reheat cooled 'C' massecuites in heaters with stationary elements through which hot water of 55°C is circulated.

As regards the design aspects, initially smaller type continuous machines with 600-800 mm. dia the top of the conical basket were installed, while the present trend is towards increasing the basket size the diameter being 1300-1500 mm. with some modern machines. The drive is provided through belts, below the machine in many cases, while in one design direct drive from motor installed inside the centrifugal is provided.

The maintenance of continuous centrifugals is simpler as compared to that of batch high speed machines

with multi speed motors, except that the screens are often required to be changed after crushing of 50,000 - 60,000 t. cane. However, the power kick experienced with batch machines, when switching over to high speed of 1450 rpm. is eliminated and power consumption is also lowered. In fact one of the major steps for reducing power consumption in sugar mill is to replace the batch centrifugals for C battery by continuous machines.

8.4 'C' massecuites are double purged, while 'B' and 'A' massecuites are either single cured or double cured. Seed from double purged 'B' massecuite can be used for 'A' boiling with advantage. It is preferable to single cure 'A' massecuite, particularly when bigger grain sugar i.e. medium or large grains is being produced.

8.5 Drying and cooling of sugar dropped from centrifugals is accomplished in grass hoppers of 15-20 m. length. Multi tray grasshoppers in which hot or cold air meets the sugar flowing over the steps are installed in many factories. Screening of sugar takes place in one or two inclined graders fitted with different mesh screens and this system has not undergone any radical change over decades.

9. D. M. C. Process

In 1965, when the country was faced with the serious foreign exchange shortage, an idea was mooted to eliminate the use of sulphur, which was an entirely imported commodity. S. C. Gupta proposed the adoption of simple defecation for juice clarification and produce sugar by adopting the usual system of boiling and producing sugar from boiling sugar melt⁵¹. This process was operated for two seasons at Aruna Sugar Factory with production of sugar corresponding the grade E30, but the process of boiling differed from the original in that the second massecuite sugar was melted and the first massecuite boiled on unsulphited syrup as well as melt. The original process was conceived on the premise that recrystallisation of sugar should eliminate the nonsucrose matter including colour. The author conducted large scale trials on different ways of producing sugar with defecation method of clarification including boiling of first massecuites on melt of low grade sugar but did not obtain sugar above 29 colour. It appears that so long as consumers are keen about whiteness and bigger grain sugar, the defecation of juice alone would not answer the needs of market. The process was discontinued even in factories which had reported encouraging results of their factory scale operations.

10. Future trends

With its capacity to absorb, innovative techniques in manufacture the sugar industry is poised for a take off that would lead to development and adoption of indigenously developed new technologies and higher norms

of efficiencies. In milling a novel concept of running the mills without pinions for the discharge rollers, proposed by M. Anand might lead to new designs of three roller mills⁵². Similarly it would be definitely advantageous to reduce the required levels of imbibition (200-250% fibre) for high extraction by bringing about thorough mixing of imbibition fluids with bagasse by recirculating the same⁵³. In clarification, new designs of clarifiers for reducing the juice retention time to minimum - half an hour or so - would certainly lead to higher purity rise than at present. New chemicals like surface active agents have to be introduced in clarification for greater elimination of colloids and other organic matter which remain unaffected in our present treatment practices. At the crystallisation stage continuous pan-boiling as also continuous crystalliser operations remain a long felt need. Control of each station with the aid of instruments and automation of every operation are new fields which require greater attention of technologists and electronics experts. Energy conservation has, of late received considerable impetus in this industry and any new developments will have to take into account this vital aspect. There is no doubt that the technological progress achieved so far is spectacular and the pace of progress will be further accelerated with the concerted efforts of technologists, industry and the research institutes of our country.

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FIG 1 A SULPHITATION PROCESS

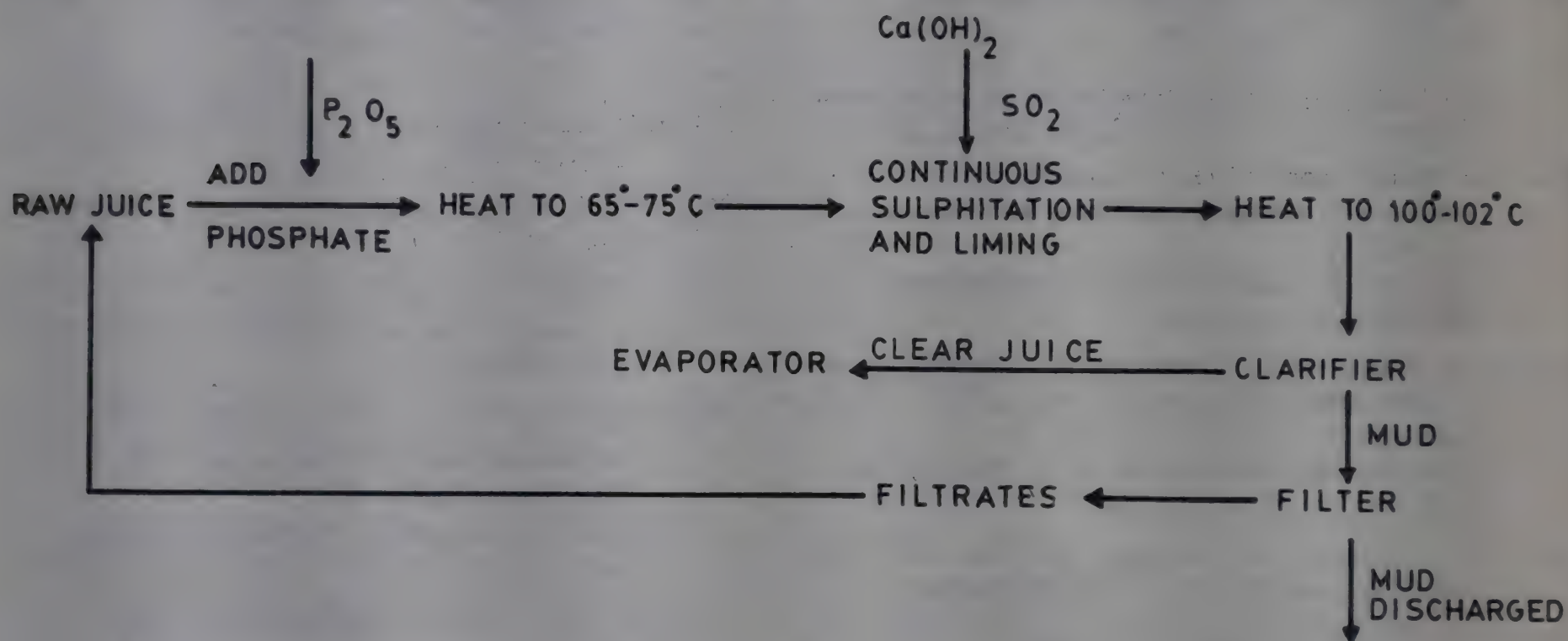


FIG 1 B DEFECATION

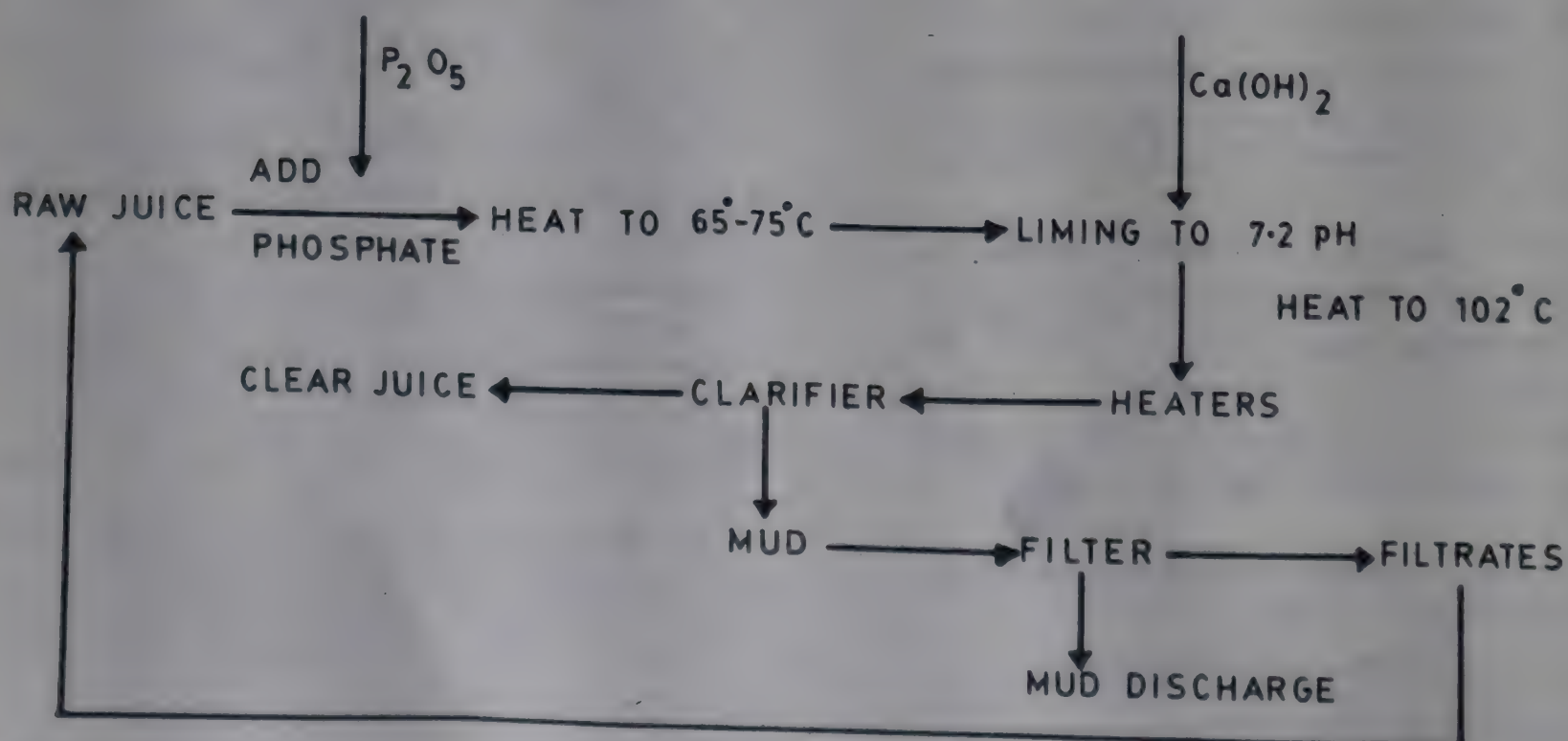


FIG 2 A

CARBONATION

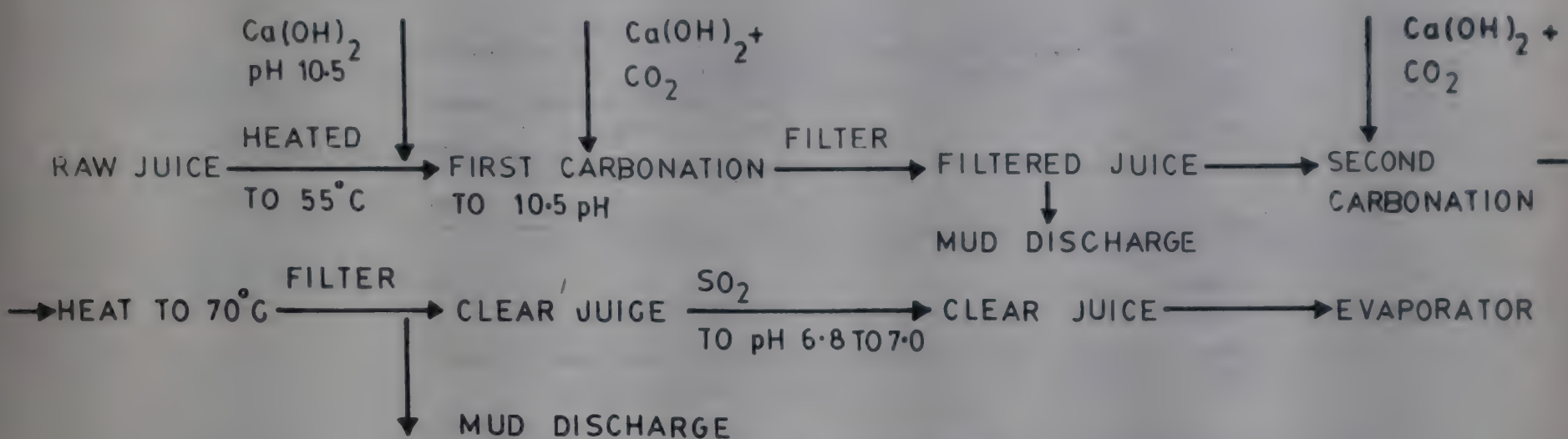
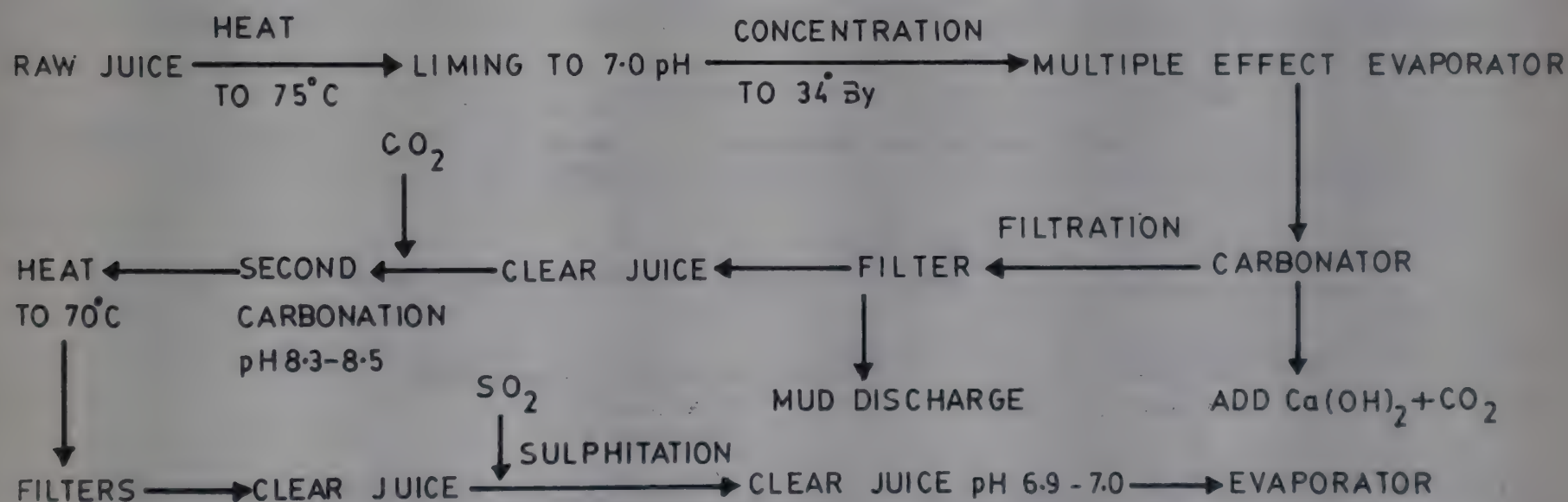


FIG 2 B

MIDDLE JUICE CARBONATION



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WALWE

Taluka Walwe, District Sangli

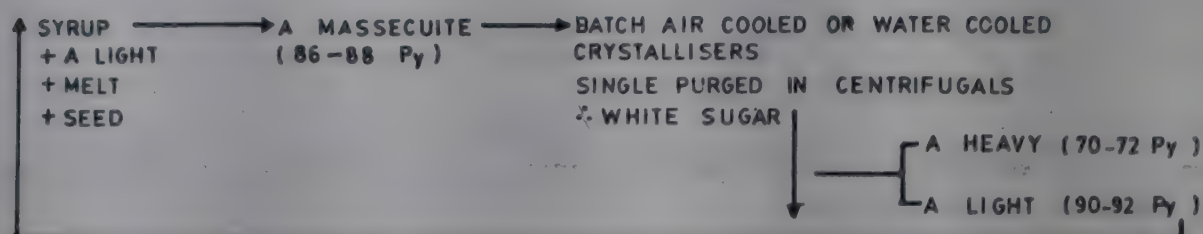
Maharashtra State

TATOBA BHAU WAJE

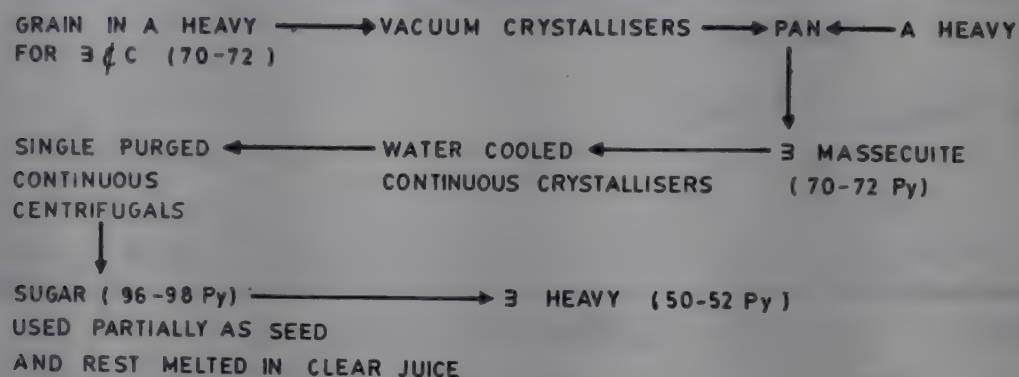
Chairman

FIG 3 TYPICAL MODEL BOILING CRYSTALLISATION & CURING SYSTEM

STAGE 1



STAGE 2



STAGE 3

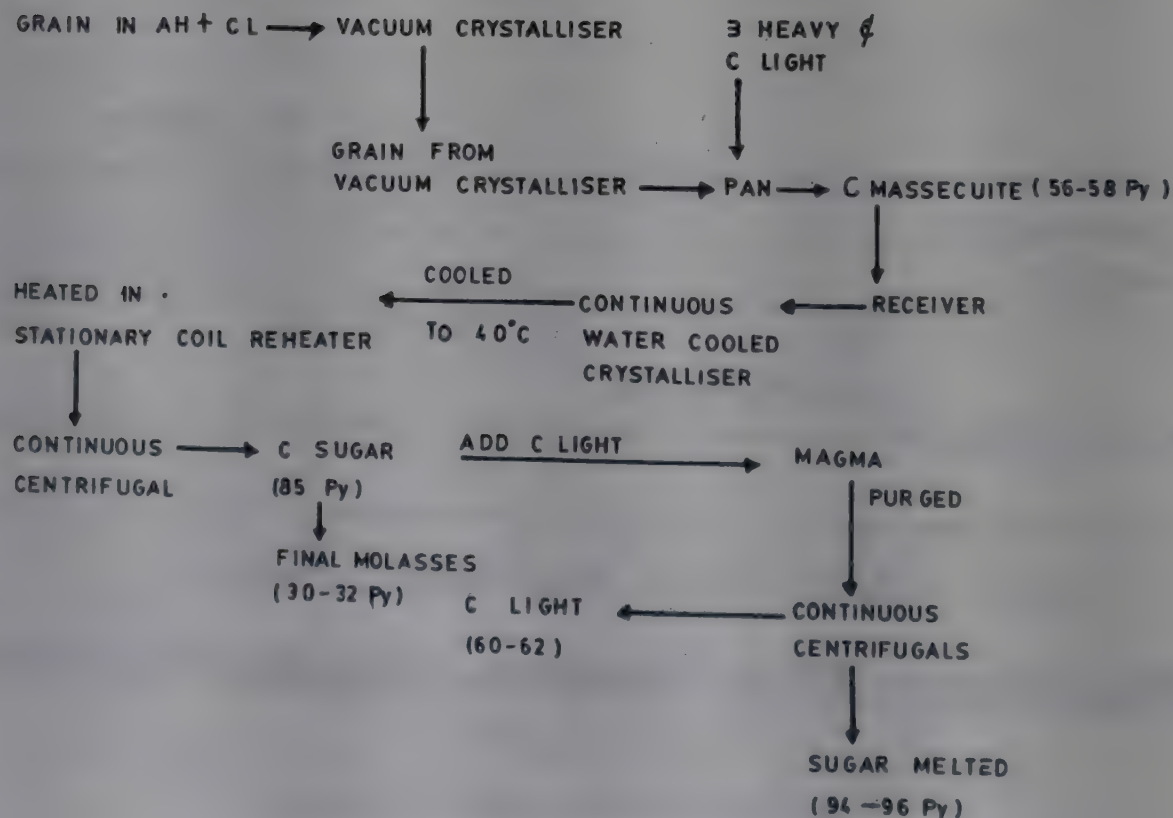
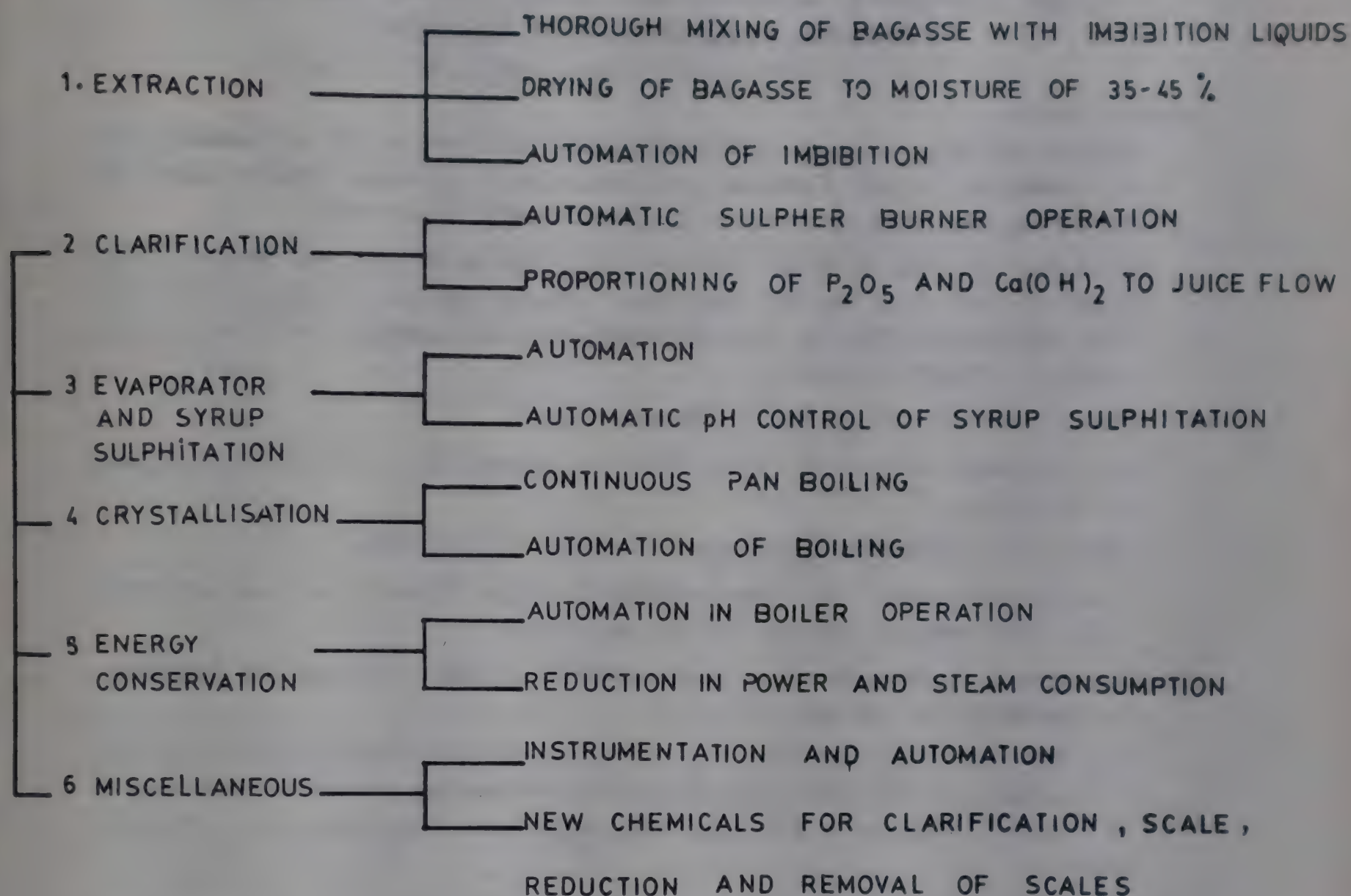


FIG 4

AREAS OF FUTURE DEVELOPMENT

SUGAR MANUFACTURE

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Sakhar
Karakhana Ltd.**

DAULATNAGAR, Tal. Patan, Dist. Satara
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Gram: KOYNASUGAR

**PRODUCER OF BEST QUALITY
WHITE CRYSTAL MARALI SUGAR
Most Economically Run Sugar Plant
S. B. Patil**

I/c Managing Director
Bandu Ramchandra Patil
Vice-Chairman

With Best Compliments from

**Jai Jawan
Jai Kisan
SSK
Ltd.**

NALEGAON, Tal. Ahmedpur,
Dist. Latur

Tel : 28 & 29 (Nalegaon)

V. B. Jagtap
I/c Managing Director

H.M. Kaymkhane
Vice-Chairman

-Adv. S.M. Patil
Chairman

And Board Of Directors

Shri Bhogawati Sahakari Sakhar Karkhana Ltd.

Shahunagar, Parite, District Kolhapur

Tel : 22 to 26 Shahunagar Gram : BHOGAWATI, Parite

Salient Features :

- * Spirited and many splendoured progress of the Kisans in the surrounding area in Economic, Social, Cultural and Educational spheres, brought about by the newly elected high powered, action-oriented leadership.
- * First rank in India in Sugar Recovery (12.45%) in the 1985-86 Season. Total Crushing was 4,33,386 MT and Sugar Production was 5,39,760 quintals; thus achieving 150% of the scheduled crushing capacity of the factory, which is a World Record.
- * Heavy demand for our White Granular Sugar.
- * Firm decision to start a Paper Plant by augmenting crushing capacity and saving bagasse.
- * Foremost in fulfilling the Revised 20-Point Programme.
- * Financial assistance for "Baal-Wadees", High Schools, as well as group marriages, family planning, Gobar Gas Plants.
- * We have firm determination to implement a Pension Scheme for Members. Agriculturists at the age of 60.
- * The duty conscious New Board of Directors will achieve maximum economy in expenses and increase Sugar Recovery Percentage and constitute a panel of Trustees to achieve the important objectives cited above in a dynamic manner.
- * Cow Production Centre

Mohan Ramchandra Maindargikar
Managing Director

Sampatrao Shamrao Patil
Vice-Chairman

Govindrao Tukaram Kalikate, M. L. A.
Chairman

Ganpatrao Dowlatrao Medsinghe
Chillappa Babaji Patil
Dattatreya Krishnaji Mahadeshwar
Krishna Nanu Birje
Dattatreya Hanmant Patil
Sadashivrao Swarupa Chirapale
Shripatrao Baburao Kamble
(Rep. of Backward Communities)
Asstt. Director of Sugar
(Government Representative)

Balwantrao Yeshwantrao Patil
Bajirao Sakharam Patil
Shripatrao Yashwantrao Chowgule
Kerba Bhau Patil
Annasaheb Baburao Patil
Shamrao Dattatreya Patil
Dnyandeo Govind Patil
(Rep. of Weaker Section)
Dadasaheb Tatoba Patil
(Representative of Bank)

Namdeo Balwant Patil
(Workers' Representative)

APPROPRIATE AUTOMATION IN SUGAR INDUSTRY

DR. G.N. ACHARYA

Abstracts

Production Technologies of many consumable commodities involving mass production have been undergoing major transformation throughout the world, replacing human skills and traditional or conventional production methods of automation, primarily based on the recent advances in electronics, computers and microprocessor based systems.

India cannot escape the impact of this rapidly moving technology making it imperative to modernise and upgrade our traditional industries like Sugar and Food Processing Industries, Paper and Wood industries, Cement industry etc. which are based on our own raw-materials. Sugar Industry, being one of our largest agro-based industries, is bound to take full advantage of this new technology, starting with appropriate automation techniques based on Distributed Digital Process Control using dedicated microprocessor based systems for various process stages.

In this brief presentation some of the critical process stages in sugar production in which automation is being introduced in stages are described in brief and after a brief review of the current status of automation, suggestions for future applications of the rapidly emerging technology of microprocessor based automatic control systems have been made.

Following areas for introducing appropriate automation techniques have been covered in fair detail, mentioning the level of improvement already achieved in some cases in India as well as abroad.

- (i) Controlled growth of cane
- (ii) Cane handling operations upto the stage of milling
- (iii) Boiling House operations
(from juice weighing to final bagging of white sugar)
- (iv) Boiler House operations
(from the point of energy saving).

1. Introduction

Production technologies of many essential commodities of mass consumption have been undergoing major transformation throughout the world replacing

human skills and conventional or traditional processing methods by automation primarily based on the recent advances in electronics and computers. The next decade is likely to face still higher levels of automation involving microprocessor based system and micro-computer control incorporating robotics, artificial intelligence and expert systems which can lead to higher productivity combined with increase in production capacity and better quality at lower cost.

India cannot escape the impact of this rapidly moving technology, making it imperative to modernise and upgrade our traditional industries like Sugar and Food Processing Industries, Paper and Wood based Industries, Cement industry, Petrochemicals, Fertilizers and Pesticides etc. and other industries based on our own raw-materials. Sugar Industry, being one of our largest agrobased industries, is bound to take full advantage of this, starting with appropriate automation techniques based on Distributed Digital Process Control using dedicated microprocessor based systems for various process stages. Processing techniques are also likely to undergo transformation with the introduction of microprocessor based Appropriate Automation Techniques in the Sugar Industry, starting from cane procurement through various process stages to final grading and bagging of sugar.

A brief review of the current level of introduction of automation in the Sugar Industry and future trends is presented here.

2. Role of Appropriate Automation

With the availability of a variety of Computer Controlled Systems and microprocessor based Systems, during the last decade, automatic control is being introduced in many countries progressively with good advantage in the Sugar Industry, at all stages from cane growth to the control of production of high quality sugar. India also has made a modest beginning in this important area. However, various factors such as inadequate data and analysis of the processes, high initial costs, large variety of processing methods used in production and Socio-economic factors have unfortunately hindered the progress

in this field which calls for more systematic and massive R&D efforts, supported by field trials in Commercial Sugar factories.

Broadly, good scope for introduction of appropriate automation in the Sugar Industry exists in the following stages of Sugar production, some of which have already been automated to some extent in many countries.

- (i) **Controlled growth of cane**
(involving controlled drip irrigation, micronutrient control etc.)
- (ii) **Cane handling Operations**
(Upto the stage of milling)
- (iii) **Boiling house Operations**
(from Juice weighing through various stages of processing such as juice purification, evaporation, centrifuging and final weighing and bagging of white sugar).
- (iv) **Boiler house Operations**
(involving various controls for improving boiler efficiency for saving bagasse).

These are discussed in brief in the subsequent paragraphs indicating the current status, scope for improvements and future trends.

3. Controlled Growth of Cane

With the continued problems of water scarcity threatening the expansion of cane fields in India, automatic Control of drip irrigation should be of great interest. Current level of annual cane production in India is about 190 million tonnes and yield is of the order of 55 tonnes/hectare which is much smaller than that in Australia and other countries where it has reached 100 tonnes/hectare. Projected production of 233 million tonnes per year with yields exceeding 60 tonnes/hectare would not be achievable in India unless suitable automatic equipment and methods are introduced as indicated below.

- (i) Automatic Analysis kit for soil analysis and grading of soil through measurement of pH, phosphate content and analysis of micronutrients.
- (ii) Automatic control of drip irrigation based on continuous sampling of soil moisture and leaf temperature.

It should be noted that area under cane cultivation which is about 3.3 million hectares cannot be substantially increased during the 7th Plan in view of the large demand on the land for pulses and oilseeds as well as food grains. Hence the necessity to introduce automatic controls for improving the yields can be well appreciated.

It has been observed that automatic control of drip irrigation results in many advantages such as saving of water upto 50%, higher germination

percentage and reduction in weed percentage. Micro-processor Controlled Automatic equipments for such systems have to be introduced on a large scale for improvements in the yield of good quality cane. Subsequently, online micronutrient control can also be introduced to ensure reasonable levels of phosphates useful for removal of nonsugars through precipitation in juice clarification. Apart from this, further R&D effort is required in early ripening and pest resistant varieties and their controlled growth for maximisation of cane yield.

Other areas where appropriate automation can be introduced are :

- (i) Mechanical harvesting
- (ii) Spray rate control for pesticides.

Problems of cane growth in areas with heavy floods require separate studies and further R&D work to introduce suitable automation.

4. Automation of Cane Handling Operations

Main operations, after the cane is received in the factory, which can be automated with advantage, are :

- (i) Cane analysis for Pol content
- (ii) Accurate weighing of cane and bagasse
- (iii) Loading on the carrier, cutting, shredding/ fiberising and feeding the mills
- (iv) Milling operation with suitable imbibition control.

4.1 Automatic Cane Analysis

One of the important requirements in the Sugar industry is the automatic estimation of the pol content and grading of cane for proper payments. Very little work is reported in this area. A "Cane Supply Automation System" developed by Tecresil and Cobra is installed in Santa Barbara factory. The system based on Cobra 305 CPU has six Tecrecil TS 100 interfaces receiving digital outputs from refractometers, saccharimeter and balances. Data on weight and composition from the cane supply laboratory are automatically processed into sucrose content and payment data. This system has been reported to be working well, and possibility of introducing the same in India may have to be explored.

4.2 Automatic Cane Weighing Systems

As per existing rules a maximum error of 5 Kgs is allowable for a 6 tonne capacity weighing bridge. Further more, mechanical systems suffer from zero drift, change of accuracy and the manual printing mechanisms used at present are susceptible to inaccuracies and pilfrages.

All these can be avoided by an automatic weighing and printing system which can give accurately a complete printed record for the day of the number of bullockcarts or trucks, cane unloaded from each

truck or cart and the total weight of cane received during the day. Additional information like cane unloaded on the carrier per day or per hour, monthly record of cane etc. may be derived from the same if a microprocessor based automatic weighing system is introduced. Automation in this stage would not only be essential for estimating the performance parameters of factories, but sugar being an excisable item, accurate weighment with automatic printing facility would be necessary.

4.3 Automatic Cane Feed Control and Extraction of Juice

Much has been written and reported on this subject, and various systems have been tried out with varying results.

Many operations governing good extraction are :

- (i) Proper cane preparation using fiberisers, unigrators or shredders
- (ii) Automatic cane feed control
- (iii) Roller adjustment
- (iv) Imbibition.

One of the earliest systems was the "Auto Cane" system introduced by M/s Edwards Engg. Corporation. This comprises of :

- (i) Level detector for cut cane
- (ii) Hydraulic motor
- (iii) Control equipment.

In the equipment, variations in the level of the cut cane are registered and totalised to furnish a signal which controls a motor. This motor drives an oil pump, output of which drives a hydraulic motor which in turn drives the shaft of the head of the carrier. Thus, the speed of the carrier is maintained inversely proportional to the thickness of the cut cane in such a way that the volume of the cut cane delivered by the carrier remains constant. However, this system, like some others, gives better results with the shredder. This system eliminates choking and maintains uniform feed automatically leading to increase in the crushing rate.

One of the systems which has found some place in the Indian sugar industry is the Automatic Cane Feed Controller (ACFC) manufactured by SICO, Allahabad.

This ACFC system senses the prepared cane level at various points on the cane carrier and feeds the level signals to the controller. Load signals of the preparatory devices also are converted to electrical voltages fed to the controller. These signals are processed in an electronic system using hard wired logic and appropriate control signals fed to the prime movers (induction motor or steam valve of steam engine or hydraulic coupling control). It is claimed

that this automatic control system reduces down-time to 20% of that obtainable with manual control, increases crushing capacity also by about 10% and reduces manpower and dependance on human skills. Pol in bagasse is also claimed to be reduced by about 0.3% on the average.

CEERI Pilani has proposed a system which is primarily based on the rapidly emerging new technology of microprocessor based variable speed AC motor Drives. This system which is suitable for a typical 2000 TCD plant comprises of the main cane carrier (about 40 HP), cutter motors (250 HP) and cut cane carrier (about 20-30 HP).

The instantaneous values of currents of the two cutter motors are sensed and used to control the speeds of the carrier and cut cane carrier respectively by controlling the frequencies of the three phase thyristor inverter drives used with these machines. The system can accept additional signals from the level transducers for final speed settings so as to ensure appropriate feed to the machines.

In the crushing & milling section, a number of advancements have taken place and reduced mill extractions of the order of 96 to 98% are being achieved. As far as automation is concerned, following parameters deserve special attention :

- (i) Life of rollers, under hydraulic pressure should be within $\pm 5\%$ at the two ends of the roller to ensure uniform crushing and as such on line sensing of the lifts of the top roller at the two ends and maintaining the same within $\pm 5\%$ automatically through suitable feedback mechanism using electro-hydraulic system.
- (ii) Automatic control of imbibition water which should be about 300% of the fibre content with adequate temperature and uniform distribution of the imbibition water to ensure better extraction of juice. Pressure and compression in the mills which govern the crushing rate and efficiency have been extensively dealt with by E. Hugot with a number of useful calculations.

Optimum imbibition to get extraction as high as 97% is reported by Ookala factory of Hamakua Sugar Co. of Hawaii. Using optimum imbibition and heavy duty shredder with feed drum, this factory has achieved in 1984 increases in milling capacity from 218.7 tonnes/hour to 243.7 tonnes/hour with decrease in pol content of bagasse from 2.15% to 1.21% and reduction in moisture content from 50.6% to 44.5%. This system uses imbibition in the form of spray of boiling water to ensure softening of the fibre. Achievable pol extraction of 96.77% and brix extraction of 95.26% have been mentioned for this system.

In conclusion it can be said that good cane prepara-

tion, automatic cane feed control, automatic milling control including roller lift control and automatic control of imbibition water to ensure good extraction are essential for maintaining high extraction efficiency and last mill brix within narrow limits.

5. Boiling House Operations

In the sugar factory boiling house, the main operations which are important from the point of view of automation are :

- (i) Juice clarification
- (ii) Evaporation
- (iii) Crystallisation (Boiling in vacuum pan etc.)
- (iv) Centrifugal station
- (v) Grading, weighing and bagging of final sugar.

Main aim of the introduction of automation in boiling house is to get maximum boiling house recovery with minimum possible energy consumption. Appropriate automation is necessary to achieve these. Current status and future trends in these process stages are discussed below.

5.1 Juice Clarification

Preheated mixed juice undergoes two stages of operation viz. (i) juice purification involving precipitation of nonsugars and decolourisation due to action of various reagents such as lime and SO_2 and (ii) setting and clarification followed by vacuum filtration before going to the evaporation stages. Automation is necessary for the purification stage. Automation is necessary for the purification stage for controlled addition of reagents.

5.1.1 Automatic pH Control for Juice Purification

Although various methods for juice purification using different reagents have been tried out in the past, only two basic methods with different variations of the same are of any practical significance. These are :

- (i) Liming and sulphitation of preheated mixed juice.
- (ii) Double carbonation, double sulphitation.

Here the discussion is restricted to the first method since, in the carbonation process, the amount of lime required is almost ten times that used in the liming & sulphitation process without substantial commensurate advantage in recovery. In fact one of the objectives of automation is to attempt high level of purification with minimum consumption of the reagents (lime & SO_2); this is possible in the liming and sulphitation process which is now more or less standardised in India and few other countries.

Before considering automation aspects it is necessary to appreciate that the main functions of the juice clarification process are as follows :

- (i) Removal of impurities by precipitations of dissolved inorganic nonsugars in some form of calcium phosphate which goes into an intricate flow that entraps and absorbs other nonsugars and separation of insoluble solid matter suspended in the juice in colloidal state.
- (ii) Bleaching by chemical treatment to render the juice brilliant and light in colour.
- (iii) To adjust and control pH value of the purified juice around 7 to ensure good purification effect and also to minimise losses due to inversion in subsequent processing.

In the subsequent paragraphs automation of a proven process involving preliming, shock liming and SO_2 controls is discussed in detail.

As far as the action of lime is concerned, the main precipitate is that of calcium phosphate $\text{Ca}_3(\text{PO}_4)_2$, possibly going through the stage of Ca_3HPO_4 . Lime and heat treatment forms a heavy precipitate of complex composition part lighter and part heavier than the juice which contains insoluble lime salts, coagulated albumin and gums. Quantity of colloids in raw juice is in the range of 0.2 to 0.29%, but they retard the filtration rate and settling rate. Role of Calcium phosphate in their removal is very important and to get correct level of calcium phosphate formation due to liming of the juice, it is necessary to ensure that the mixed juice reaching the juice purification stage contains at least 300 ppm of P205. Removal of colloids as completely as possible, therefore, in the earlier stages of juice purification and prevention of any fresh formation of colloids in this stage is of utmost importance hence automatic control to ensure this of immense value in the liming stage.

Another important action of lime in this stage is that of charge neutralisation. Colloidal particles in raw juice bear a negative electric charge, which has to be neutralised or reversed for better precipitation. Milk of lime plays very important role in this because the positively charged Calcium particles are attracted towards the negatively charged colloidal impurities resulting in "floc" formation which settles down faster.

Without going into the dialogue of liming first or sulphitation first or both together, it can be stated that automatic control of this liming process--preliming stage -- should be based on the precipitate formation and flocculation. The formation of Tricalcium phosphate is obviously related to the P205 content of the limed juice.

Automatic liming control developed by CEERI Pilani indicates that the initial level of P205 is brought down to about 50 to 70 ppm at about pH = 7.2 by liming the mixed juice at 70 to 72°C and any further liming has little effect on the P205 content. Furthermore,

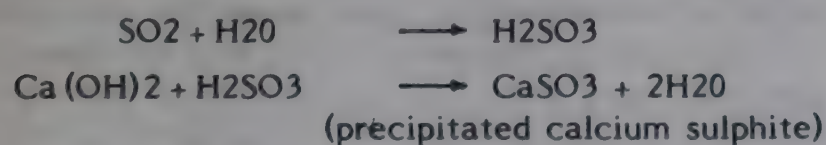
it has been observed after extensive studies that prephosphitation of the juice (before liming) to levels beyond 350 ppm is of no value because it consumes proportionately more lime without any additional advantages and also requires higher prephosphitation which is costly. Thus an automatic preliming control incorporating a microprocessor based control system in which the target pH value corresponding to minimisation of P205 content is entered gives the best results in this first stage of clarification.

Nonsugar removal is, however, a more complex process and further liming for increasing the pH through "shock liming" is necessary since some of the precipitates like SiO_2 , Al_2O_3 , MgO and Fe_2O_3 which are responsible for scale formation in the evaporators are best removed at pH values exceeding 7, normally between 8 to 10.5 pH. However, high liming leading to pH values exceeding 8.5 for longer times has detrimental effect on the juice because of excess of soluble lime salts, decomposition of reducing sugars with attendant colour increases and resolution of reducing sugars with attendant colour increases and resolution of some nitrogenous bodies. Hence, in the shockliming stage also where juice pH is raised to about 10 to 11 for a very short time, not exceeding 10 seconds,

automatic pH control is necessary. Here again CEERI has observed that the pH value to be set for shockliming and to be entered through the microcomputer for good precipitation, is determined by the minimisation of the rise of CaO content in the treated juice after sulphitation. A plot of final CaO rise as function of pH value of shocklimed juice indicates that the set limit works out to be around 10.2, although the actual setting may vary from place to place depending on the quality of cane juice.

The shocklimed juice is finally treated with sulphur dioxide to get neutral juice with pH = 7. This has the following action on the juice :

(i) It neutralises the excess quantity of lime as indicated below :



Here formation of calcium bisulphite $\text{Ca}(\text{HSO}_3)_2$ must be avoided since it decomposes and releases SO_2 later, corroding the pipes. Hence the necessity of automatic control of SO_2 , to avoid excess SO_2 .

(ii) SO_2 bleaches the juice by acting on the colouring matters.

(iii) It decreases the viscosity of juices, thus increasing the flow rate.

(iv) It reduces to colourless compounds the ferric

salts formed in the juice due to the contact with the mills.

To sum up, a typical, well tried out automatic liming and sulphitation system using microprocessor based controller performs juice purification in following three stages :

(i) Preliming control for maintaining pH value corresponding to minimisation of P205 content by automatic adjustment of lime feed.

(ii) Shock liming control for adjusting liming to attain and maintain the pH value at a point corresponding to minimisation of relative rise of CaO content of purified juice.

(iii) SO_2 control to attain a value of pH = 7 for the final treated juice.

All values of pH can be controlled within ± 0.1 pH with modern pH sensors in the form of sensitive glass electrodes and sophisticated low cost dedicated microprocessor based controllers.

In the field of automatic pH control for juice clarification the earliest reference is that of the work of Dr. S. N. Gundurao, P. V. S. Shastry and Mr. R. Bhalerao who used the then available Kent universal pH recorder and vacuum tube amplifiers with glass electrodes. This equipment was tried out in Ravalgaon Sugar Farm Ltd., Ravalgaon, with some success and this work was reported in ISSC 1956. But because of the basic limitations of this system it did not receive wide acceptance in the sugar industry.

Another automatic pH controller is the one manufactured by Leeds and Northrup termed as "Micromax", which also records on a chart the indications of a galvanometer, but this also demands very careful maintenance.

Recently, automatic lime feed control system with digital set point control developed in India by CEERI has received acceptance in the sugar industry because it can maintain the pH within ± 0.15 pH around the set value and the microprocessor based version described above has gone into production after limited field trials.

M/s Sonapat Cooperative Sugar Mills Ltd. have installed automatic pH control equipment using lime feed control system and have obtained good results with a clear reduction in CaO content of the order of 100 to 200 mg per litre and also rise in purity over manual controls. Similar results and better pH control has been reported by Shree Valsad Sahakari Khand Udyog Mandali Ltd., Valsad, Gujarat and M/s Sanjeevani Sahakari Sakhar Karkhana Ltd. Kopargaon, Ahmednagar, Maharashtra State. All are using the automatic pH control system manufactured by M/s Satwik Electric Controls Ltd. based on the design developed by CEERI,

Pilani.

In almost all automatic juice purification controllers, the main problems are related to the non-uniformity of juice flow, large variations in the SO₂ generation and variation in the quality of lime and its concentration in the milk of lime. A good automatic controller has to take into account all these variables and give warning signals when the juice flow goes down or the SO₂ burner stops or any such extreme situation arises.

A microcomputer based automation system for juice purification should therefore, be based on the on line monitoring of the following parameters:

- (i) Juice flow rate
- (ii) Temperature and pH of incoming preheated juice
- (iii) Flow rate and temperature of milk of lime
- (iv) SO₂ percentage and flow rate
- (v) pH values of prelimed, shock limed and sulphited juice (to be maintained at present limits for best clarification).

It has been observed that the three level pH control system involving preliming, shock liming and SO₂ control gives a higher rise of purity in the purified juice varying from 0.3 to 0.5%, higher settling rate of the order of 20.0% or better than manual control. Maintenance of pH value within narrower limits improves precipitation of nonsugars to the extent that the scaling of evaporation is reduced leading to less number of cleaning operations and shut downs.

Good amount of work is being reported on the development of special pH electrodes, which is the most important critical element in the system. An Antimony Ring Electrode System with an automatic wiping mechanism is announced by M/s Polymetron Switzerland and is being marketed by M/s J. N. Marshall Ltd. Pune, but this has to be still tried out in the Indian Sugar Industry although it has been claimed to have been tried out in the beet Sugar industry for the Carbonation Sulphitation process.

Associated automatic systems are:

- (i) Integral Sulphur burner control based on automatic control of SO₂ generation and control of air intake to give uniform SO₂ percentage in the SO₂-air mixture.
- (ii) Automatic control of the process for preparation of milk of lime.

For lime making process, Australian sugar factory has tried out an automatic control system to full advantage. In this system, a regulatory valve in water feed line receives the output from a summator to whose inputs are connected (a) sensor temperature in the vapour-air mixture (b) via a fixed-factor

multiplier unit; sensor of incoming water temperature "Quick lime" is regulated by a level sensor in the mixer.

5.2 Evaporation

Considerable work remains to be done to come out with a good automatic evaporator control system acceptable to the Indian Industry.

As far as basic structure of evaporation system is concerned very little has changed, since Rillieux invented the "multiple effect" evaporator in 1844. This is considered to be one of the most significant inventions leading to steam economy since direct steam is used only once at the input and for subsequent stages, the vapour produced by the boiling juice is repeatedly used. The quadruple effect evaporator has now become more or less the accepted practice in most of the sugar factories.

Any automatic control used in this must be aimed to achieve minimum possible steam consumption, and uniform variation in the concentration of juice from about 15 brix to 60 brix with correct levels maintained in each stage of evaporation. Computer simulation studies by Spanish engineer L. Hernadez have indicated that if all parameters such as clarified juice temperature and brix, syrup brix, heating steam pressure, pressure distribution, number of effects and condensate autoevaporation are taken into account, it is found that minimum steam consumption is obtainable with Quadruple evaporators with bleeding from the first three vessels.

Although automatic measurement and control of brix of the syrup would possibly be an ideal way of controlling the evaporator stage for achieving the desired performance, it has been reported that syrup density through on-line measurement is not a very accurate method and is found to be unreliable by some workers.

If level, steam feed and pressure and vacuum are automatically controlled and kept within acceptable limits by introducing a good magnetic flow meter for flow stabilisation at the input, brix of syrup from last body gets automatically controlled and can be kept within (62 ± 2) . One of the problems commonly faced in the evaporator station is that of entrainment. Due to entrainment or leaks in the calandria of evaporators and pans, the condensates get contaminated with sugar. If this contaminated condensate goes to the boiler, it will damage the boiler tubes and prime movers. An automatic system based on online detection of sugar traces in condensate and diversion of the same to pan hot water tank or to drain may be desirable.

One of the important variables in the evaporator

station is the level of juice. If the level is too low, the boiling juice cannot reach to the top of the tubes. In that case, there will be no circulation of juice in the calandria. If the level is too high the tubes will be drowned or fully submerged and there will be no climbing film. Experimental observations on evaporators have indicated that the best heat transfer coefficient of the order of 90 to 100% is obtainable when the hydrostatic level of the juice in the calandria is kept between 30% and 40% of the height of the tube. Automatic control of evaporators, therefore, has to be designed to achieve this goal. As indicated earlier another parameter to be automatically controlled and maintained within close tolerances is the syrup brix (62 ± 2).

In the Babcock and Wilcox Evaporator Control System, level regulators combined with a control assembly for regulating brix and evaporation rate are used. The system uses a vapour regulating valve to achieve automatic control of the syrup brix.

In the evaporator control designed by Siemens also level control is given the highest priority and for level measurement a flange-mounting flow transducer is recommended by them. This ensures that the evaporators are filled to a level at about one third of the calandria height. It also incorporates make up steam control using back pressure steam in case of reduction of vapor supply in the third effect. Limiting control of steam supply to boiling station is also used in this system; in which, the controller compares the actual steam flow rate supplied to the boiling station with the limit value permitted. If the flow rate exceeds this limit the controller actuates the steam damper until the flow limit is again obtained. In addition to these, syrup consistency control using isotopes (isotope density meter) is recommended by Siemens.

Taking into consideration the various parameters to be controlled and the developments that have taken place in introducing various levels of automation, it can be concluded that a microprocessor based system incorporating following can be used

- (a) Juice flow stabilisation at input of evaporator,
- (b) Level stabilisation around (35 ± 2)% of the height of calandria tubes,
- (c) Steam pressure and flow control to maintain syrup brix at (62 ± 2),
- (d) Control of vapour bleeding and temperature,
- (e) Periodic monitoring of the heat transfer coefficient to maintain steam economy.

In addition, an auxilliary control system for minimising the problem of entrainment may also have to be provided.

5.3 Automation Schemes for the Sugar Boiling and Crystallisation Process

Automatic control of the crystallisation of the thick syrup is the most difficult task in the production of good quality sugar. Naturally enough, it has received special attention of the sugar technologists as well as physicists who have always been fascinated by the fundamental processes which govern the formation of good quality sucrose crystals without conglomeration.

Ultimate objective of all automation and instrumentation techniques used in the Pan Boiling Stage is to extract maximum amount of crystals of uniform size in minimum time with minimum amount of energy consumption, without forming any conglomerates.

In sugar crystallisation process, the supersaturation of the mother liquor around the crystals is the most important variable. Crystallization velocity is proportional to supersaturation and nucleation rate is also proportional to the level of supersaturation.

Considering the basic physical process of supersaturation, it is observed that if the relative sugar content in the solution is plotted as a function of temperature, (50 to 90°C) the times of equal saturation and supersaturation indicate following three clear zones in the region of supersaturation

(i) Metastable zone with degree of supersaturation lying between 1 and 1.2. In this zone existing crystals grow in size, but practically no new crystals are formed. Here the range of brix is approximately 81 to 83.5.

(ii) The 'intermediate' zone is the one in which the degree of supersaturation varies from 1.2 to 1.3. Here the range of brix is approximately 83.5 to 85°. In this zone, not only the existing crystals can grow, but new crystals also are formed.

(iii) The 'labile' zone (or the unstable' zone as it is sometimes called) in which degree of supersaturation varies from 1.26 to 1.4 (Brix would be normally higher than 84.5°).

It has been reported that in a fairly pure syrup, crystals will grow at the rate of 375 microns per hour on the mean dimension when the syrups are below 65% of oversaturation limit. This is equivalent to the maximum crystal growth rate of 375 microns/hour/sq. meter; beyond this growth rate there may be the danger of formation of conglomerates. Although ultimate aim of any pan automation scheme is to get maximum number of sugar crystals of uniform quality, the main objectives to be achieved in any automation schemes are :

- (i) Minimum consumption of energy
- (ii) Fastest rate of growth of the sucrose crystal starting from 2-3 micron grain to 0.3 to 0.5 mm sucrose

crystal without forming any conglomerates i.e. minimum boiling time.

(iii) Favourable water evaporation preferably keeping rate of water evaporation the same throughout the boiling period

(iv) Maximum uniformity of crystal size

(v) Optimum desugarisation and minimisation of the purity of molasses in the final pan so as to minimise the losses.

Most of these conditions are achievable in modern automatic pan boiling schemes, but the real problem is that direct on-line measurement of parameters like purity, brix and degree of supersaturation which is the most critical parameter for measurement and control, is not possible because of the lack of suitable transducers. A summary of the various methods used in practice and their relative merits/demerits from the point of view of automatic control are summarised in Table 1

Considering the above overall merits and demerits of the various techniques of Automation of the sugar crystallization processes, one can see that the picture is pretty confusing and no single method can be considered suitable for all types of pans and under varying degrees of purity.

In the microprocessor based pan boiling scheme proposed by CEERI values of the viscosity and high frequency conductivity are directly measured and brix and purity which are dependent on viscosity and conductivity respectively are computed from the measured values using curve fitting techniques based on experimental data averaged over several pans for constant vacuum and steam flow rate. The degree of supersaturation is derived from these parameters.

In the microprocessor based pan monitoring system (called MIPMOS) following parameters are measured 'on-line' as accurately as possible

- (i) Temperature of the massecuite
- (ii) Viscosity of the massecuite using Siemens viscometer
- (iii) AC Resistivity as a measure of conductivity of the massecuite using the CEERI panometer
- (iv) Level of the massecuite in the pan
- (v) Steam flow rate and vacuum

The microprocessor based system converts on computes the following variables of interest and displays them digitally on a panel :

- (i) Measured values of AC resistivity, viscosity and level
- (ii) Computed values of the degree of supersaturation

Apart from serving as an aid to the pan man,

the equipment generates signals for automatic control. It is hoped that such multiparameter control system would help in better automation of the pan boiling process with inherent facilities for monitoring the supersaturation degree at each level.

5.4 Centrifugal Separation

The operation of separation of the sugar crystals from molasses is carried out in centrifugal machines variously called as "Centrifuges" or "Centrifugals" etc.

Automation is necessary for control in both batch type as well continuous centrifugals and micro-processor based systems can play very useful role in the same.

Although introduction of continuous centrifugals is a good step in the direction of automatic control of the centrifugal process, further R&D work is necessary for automation of the latest microprocessor based AC Motor Drive Controls which can replace multiple machines having discrete speeds. There is a possibility of minimising the mechanical couplings in the form of pulleys and belts used for varying the speeds, by introducing variable frequency AC Motors Drives using microprocessor based three phase thyristor or transistor inverters. One of the most efficient point on the torque-speed characteristics by adjusting the voltages and frequency.

One of the recent developments in automation in centrifugal station is the use of reflectance meter in low grade continuous centrifugals. Feed of massecuite and water to low grade continuous centrifugals can be controlled to produce sugar of uniform colour and purity if a continuous measurement of reflectance of sugar near the top of the basket is used as the controlling variable. In this system a chopped beam of light is reflected by the sugar crystals and this reflected beam is received by a phototransistor. Uniform illumination is ensured and measuring channel converts the measured reflected light signal into a 4-20 mA output proportional to sugar colour which controls the massecuite feed.

One of the automatic controls which deserves special attention for further development is the automatic control of the speed of the centrifugal machine. Optimum speed of the machine is dependent on the viscosity and brix of the massecuite and for increase in either viscosity or brix the speed should increase while with temperature it should decrease in proportion to the decrease in viscosity. Whereas belt driven systems are operating, variable frequency solid-state AC Motor Drive which can automatically adjust the centrifugal speed would be a better solution.

6. Energy Management in the Sugar Industry

Sugar industry as one of the sources of energy

has been well recognised, all over the world and recently there has been an increasing awareness in our country for the use of this as a source of surplus energy. Proper energy management can result in saving of fuel which can be used for paper production. Efficient generation and economic utilization are two basic components of energy management which deserve special attention in the sugar industry.

Energy from sugar industry is obtainable primarily in the following two forms :

- (i) Electrical energy from a steam turbine operated on a bagasse based boiler system.
- (ii) Alcohol and other products from molasses for use as fuel.

It has been estimated that in a well designed modern factory about 1000 Mega Joules per tonne of cane is required to produce sugar. But the bagasse available has a potential for 2000 Mega Joules and there is surplus energy available to the tune of 1000 Mega Joules per tonne which can be utilised either for producing 50 KWh of surplus electricity per tonne of cane or about 9 tonnes of surplus wet bagasse per 100 tonnes of cane. Although at the rate of 50 KWh per tonne of cane crushed, the surplus energy obtainable from the sugar industry may appear to be comparatively insignificant in relation to the large unfulfilled demand in India, the main points to be appreciated are that this is a fairly large amount of surplus energy by itself available from a renewable source and it will be available in the rural surroundings of most of the sugar factories where it is needed most. As such this significant potential contribution can not be ignored and suitable instrumentation may be developed to see that this surplus energy does become available. To move towards its realization, much more attention must be given to steam economy within the sugar factory and especially improvement in the boiling house using modern Instrumentation and Control methods involving the use of microprocessor based systems. Here again there has to be a multipronged approach involving proper rearrangement and automatic control of the evaporators, heaters and pans to reduce the steam consumption, proper bagasse drying system reducing its moisture contents to raise its calorific value and suitable boiler instrumentation and control for improvement in its efficiency.

Since the sugar factories have to, of necessity to install boilers and turboalternators to meet their own needs of electrical energy, it is possible by investing some additional temperature steam from boilers and thereby generate, surplus electrical energy.

In addition to this, increasing the calorific value of bagasse by reduction in moisture content, use

of high pressure boilers for generating more energy from the same amount of steam and implementation of energy conservation methods using proper temperature control through modern instrumentation should be another aspect of overall energy management in the Sugar Industry.

Thus, introduction of advanced microprocessor based Instrumentation and Automatic Control Systems for energy management in the Sugar Industry can have two basic objectives :

- (i) Energy conservation, leading to minimum energy consumption, fuel economy resulting in surplus bagasse for paper production.
- (ii) Generation of surplus energy through higher efficiency and additional installed capacity with suitable controls.

In the next few paragraphs attempt has been made to identify the specific process steps where improvement is possible from the point of efficient energy management and, wherever possible, the improvement possible has been quantified and the measurement and automatic control system is indicated.

6.1 Cane Movement, Cane Preparation and Juice Extraction

Optimum feed of cane to the mills maintaining a proper crushing rate decreases the effective moisture content of bagasse and increases its fuel value. Effectively one can say that optimum cane feed and proper crushing rate can lead to the following :

- (i) Reduction of moisture content by 2% leading to about 4% increase in calorific value of the bagasse fuel (GCV changing from 4106 Btu/lb to 4273 Btu/lb as shown below).
- (ii) Increase in crushing rate by 10% results in overall reduction in steam consumption 1.5%.

Following table indicates the effect of reducing moisture in bagasse :

Moisture as % bagasse	45	48	50	51
GCV	4523	4273	4106	4023
NCV	3698	3434	3259	3171
Condensation loss & GCV	18.2	19.5	20.6	21.6

Predrying of bagasse which can effectively increase the net calorific value of bagasse fuel has, therefore, been identified as an important step in energy management and control. The moisture content measurement and control is the main parameter under consideration here.

Condensation losses in boilers which is dependent on the moisture content in bagasse is approximately 19.5% corresponding to 48% moisture in bagasse. Normally in practice about 5% reduction in moisture is possible leading to raising the calorific value by about 10%.

Flue gas heating has been the accepted practice for drying of bagasse. - Thus, reduction of moisture content of the bagasse by drying with the help of flue gas and by the introduction of more efficient methods of juice extraction ultimately increases the calorific value of the bagasse which is the main fuel used in the sugar factories. In order to quantify and monitor the advantages obtainable with the reduction in moisture in bagasse, it is necessary to have proper instrumentation involving electronic weighing methods as already described.

6.2 Preheating of Inlet Air for Combustion

Although the upper limit of the temperature of the preheated air is dictated more by economically viable limit of waste heat recovery, one of the observations in this respect is that increasing the combustion air temperature by 50 C can contribute upto 2% to the overall boiler efficiency.

Further more, air preheating normally requires two fans - one for forced draught and other for induced draught. Thus, the main parameters to be measured in air preheating are combustion air temperatures and the draught rate. An electronically controlled variable frequency AC drive for draught control is a good possibility.

6.3 Economiser

Economizer is for heating the feedwater entering the boiler. Feed water should not, however, be heated to approach within 10 C of water temperature within the boiler. The boiling point being about 216 C (421 F) at 300 Psig the economizer outlet temperature should not exceed 188 C (370 F approx.), which can be achieved by having the economizer heating surface to be upto 40% of the boiler heating surface. Thus, temperature measurement and control is an important parameter here.

6.4 Flue Gas Temperature and Composition

Sensible heat loss comprising of the heat carried by the mass of dry flue and the heat of superheated of the water vapour is of the order of 19% and this can be reduced by -

- (a) decreasing the air intake to minimum necessary for efficient combustion, and
- (b) reduction of temperature of flue gas.

For 40% excess air intake, if the temperature is reduced from 371 C (700 F) to 149 C (300 F) sensible heat can be brought down from about 21.7% to 14.9%.

It is normally not desirable to bring the flue gas temperature below 150 C due to risk of corrosion of the chimney and heat recovery unit.

Another parameter to be measured are the CO₂ content and O₂ content which are indicative of the combustion rate and efficiency. Normally O₂ content in flue gas should not exceed 4% since this will be an indication of excess air which gives additional heat loss. Alternatively CO₂ content also may be measured. Depending upon the O₂ or CO₂ content the air dampers may be automatically operated so as to control the combustion. Heat loss in the flue gases is directly proportional to the amount of excess air used; hence for efficient boiler operation, excess air should be kept to a minimum. For control purposes CO₂ content of flue gas can be used since more the excess air, less will be the CO₂ content provided that CO is not formed. Recently in large installations, automatic air damper control has been used to get controlled combustion. The system normally operates with Oxygen feedback and this is achieved by means of Zirconium oxide cell. Recent techniques involve the sensing of carbon monoxide (CO) and adjust the controls to minimise the same.

To sum up some of the areas where microprocessor based Electronic Instrumentation and Control Systems may play a useful role are :

- i) Boiler feed water treatment control using on line measurement of pH conductivity and temperature.
- ii) Excess air control with oxygen monitoring for controlling Air/Fuel ratio using Zirconium Oxide Sensors and minimisation of CO using microprocessor control.
- iii) Flue gas temperature control (and oxygen monitoring as above).
- iv) Bagasse drying using Flue gas using on line measurement and control of moisture.
- v) High Pressure Boilers (450-900 Psig): Microprocessor based measurement and control of steam pressure and temperature surface crack detection system using acoustic emission detection technique and microprocessor-based monitoring system for high pressure boilers.
- vi) Fluidised Bed Combustion Technique involving control of air flow rate, fuel feed rate and temperature measurement and control.

7. CONCLUDING COMMENTS AND FUTURE OUTLOOK

The above gives a bird's eye view of some of the production processes in the sugar industry, where advanced electronic techniques involving

the use of microprocessor based controls can be introduced with clear advantages. In addition to the above, microprocessor based Automation systems can be incorporated in the collection, analysis and print out of the data obtained periodically from the laboratory analysis. Operations dependent on the data obtained from laboratory analysis such as sucrose content, phosphate content and fibre content of sugarcane, purity rise in clarification etc. can be more expeditiously performed with the help of a microprocessor based data acquisition and processing system. For improvement in sugarcane production convenient and accurate portable instruments such as microprocessor-based soil moisture analysis for drip irrigation, moisture meters and other instruments based on microprocessor control can be developed. It is necessary to set up a dialogue at the technical level between sugar experts and electronics experts

to work out a national strategy and plan for the development of the whole range of microprocessor based instrumentation of our Sugar Industry. In order to have a meaningful dialogue and implementation of the modernization schemes using microprocessors and minicomputers in the Sugar Industry, it may be necessary to identify at least two factories where full facilities for experimentation can be available and field trials can be carried out on the electronic equipment being developed in our National Laboratories.

8. Acknowledgements

The author wishes to record his gratitude to his senior colleagues for their untiring efforts in design, development and field trials on Microprocessor Based Instrumentation and Automatic Control equipment being introduced for modernisation of our Sugar Industry.

Best Wishes For Diwali
to our Farmer Members, Traders, Consumers, Workers and Wellwishers

Shri Siddheshwar Sahakari Sakhar Karkhana Ltd.

MANIKNAGAR
Taluka Sillod, District Aurangabad

Salient Features of our Factory

- * Expansion of the factory undertaken from 1250 TCD to 2000 TCD.
- * Manufacturers of White Crystal Sugar and Alcohol
- * Distribution Scheme of Co 7219, CoC 671 and Co 7704 sugarcane seeds to farmer members
- * Sugarcane plantation Government subsidy made available to backward class small and marginal farmer members
- * Financial assistance provided to backward class small and marginal farmer members for purchasing shares of the factory as per Government Scheme.
- * Established a Polytechnic for providing advanced technical education in rural area
- * Commissioned a seed nursery for the benefit of the farmer members in our area of operation.

M. N. Jadhav
Managing Director

R. S. Patil
Vice-Chairman
and Board of Directors

Manikrao Palodkar
Chairman

TABLE I

Relative merits and demerits of automatic control schemes for crystallisation

Method of controlling the crystallisation process	Range and conditions of Applicability	Remarks regarding limitations, relative advantages etc.
1. Boiling Point Elevation (BPE) [BPE or boiling point rise (BPR)], as it is sometimes called, is the difference between boiling point of massecuite and that of water, both measured under the same conditions of vacuum. BPR is thus directly proportional to the ratio of solute to water in the solution].	- Pure sucrose solutions under crystallisation conditions - Constant vacuum conditions are required.	i) No information obtainable about the crystal content of massecuite. ii) With impure solutions it measures only the dry substance and not the sucrose concentration, hence degree of supersaturation cannot be defined accurately using this method. iii) Constant vacuum is necessary for accurate indication of supersaturation in terms of BPR.
2. Conductivity (or AC resistivity) Principle of this method originally introduced by Peter Honig is based on the fact that there is a definite relationship between the degree of supersaturation and conductivity in magmas of equal purity quotient. Measurement of AC resistivity of the massecuite in which comparatively high frequency source (about 20 kHz) is used and effect of capacitive component is eliminated gives a fairly good relationship between purity and resistivity. Since conductivity of a solution depends on the mobility of ions, it decreases with increase in crystal content.	Sugar being a dielectric, and the capacitance as well as the resistance of the boiling massecuite changes with the saturation level. Cuitometers used in the early stages of development neglected the capacitance variation and as such suffer from inaccuracies. Panometer developed by CEERI eliminates the capacitive effect and has been found to be of great help in boiling low grade massecuites. But the conductivity methods to some extent depend upon purity. In practice the purity of massecuite is also considered as a parameter and conductivity supersaturation relationship has to be plotted with purity as a parameter. The main limitations of the use of the conductivity method for automatic control are that it is not accurate enough at high purities exceeding 90% and for varying degrees of purity.	Conductivity of high purity juices drawn into the vacuum pan is small being of the order of 50 micro-siemens/cm. Only a small change in the absolute value of conductivity results in a big displacement of the zero point for calibration of supersaturation level. Conductivity measurement is, therefore, recommended for solution not exceeding 90% purity levels. Furthermore, degree of supersaturation is a strong function of temperature. To be able to get correct information about the process dynamics for automatic control, one cannot depend entirely on a single variable for automation of the pan boiling station. Hence conductivity based equipment has to be supplemented by viscosity and temperature measurement to have effective automatic control of the pan.
3. Viscosity / Consistency There is definite relationship between degree of supersaturation and viscosity of constant temperature and being independent of purity, it gives a fairly good estimate of the brix and degree of supersaturation.	In this method, dependence on purity is negligible at high purities whereas at low purities, the dependence is as great as the purity dependence on conductivity. Consistency measurements are difficult to use during the grading period, but they are undoubtedly excellent for the final part of the strike where the aim is to adjust the crystal content.	Although viscosity based automatic control were tried out successfully few years ago, their limitation of low sensitivity at high levels of purity, the large size and cost involved in the rotating cylinder viscometer have, in the past limited the use of this equipment as the main automatic controller. Modern versions of the viscometer with convenient mounting arrangements combined with a suitable high

TABLE 1 (contd.)

Method of controlling the crystallisation process	Range and conditions of Applicability	Remarks regarding limitations, relative advantages etc.
4. Refractometer Brix Refractive index of massecuite can be found out by a refractometer based on critical angle of total internal reflection of a beam of light. Refractometer readings can be calibrated in terms of brix since the refractive index depends on concentration. This instrument can therefore be used as a measure of the degree of supersaturation.	Only refractometers with the prism mounted in a probe inserted at least 3 inches from panwall can give satisfactory response. Refractometer can be used for measuring the dry matter content in the mother liquor (brix). But almost all the refractometers need temperature compensation. Temperature compensation necessary at constant supersaturation indicates that it has to work in opposite direction before and after graining, because a rise of temperature causes remelting of the crystals which are grown.	frequency conductivity meter have started gaining popularity in automation. Refractometer brix alone cannot be used as an aid in automatic pan boiling because, refractive index of mother liquor is independent of crystal content. Although this is an advantage in the first part of the strike, it makes it impossible to finish a strike by refractive index control. Recently Finnish Sugar Co. reports that a microprocessor control of sugar crystallisation involving use of the refractive index and final density by a radioactive density meter have enabled them to determine exact supersaturation. Such a process involving on line measurement of refractive index and total density has been found to be useful for automatic pan boiling.
5. Dielectric Behaviour at high Frequency (150MHz) Using Onsager's formula dielectric constant K_r of a complex substance like the massecuite is given by $K_r = aK_s + bK_{ds} + cK_w + dK_i$ where K_r = Resultant dielectric constant of the massecuite aK_s = Contribution due to crystallised sugar bK_{ds} = Contribution from dissolved sucrose cK_w = Contribution due to water dK_i is small quantity due to impurities and can be neglected. In the method proposed by De Danske Sukerfabrikker of Denmark, a cylindrical teflon-insulated rod antenna of approximately 200 mm (varying between $1/8$ and $1/4$ of wavelength) is used and excited at 150 MHz. Reflected signal is used as the measure of the relative dielectric constant of the sample. Principle of measurement is based on the measurement of the change of impedance at 150 MHz where the impedance to a large extent depends on dielectric constant of the medium and less on ohmic resistance. The change in dielectric constant of massecuite results in corresponding change in the amount of reflected power. This signal is picked up and processed into 4 - 20 mA control signal.	Control of concentration and crystal content based on changes of the dielectric constant at very high frequency can be achieved. In order to get an effective relationship to the crystallisation state it is necessary to have the antenna placed in such a way that the surrounding walls of the pan form an effective and uniform Faraday case which is totally filled with massecuite, hence the antenna is mounted in the bottom of the pan. This method is recommended by the manufacturer specially for high purity level between 90 and 100% in which range the other methods have limitations.	In the most advanced fully automatic control of the complete pan boiling strikes automatic control of opening and closing of valves is used and it covers all points from the first charging with fresh syrup until final discharge and cleaning. Both conductivity electrodes as well as dielectric rod antenna are used for on-line control of degree of supersaturation. Main advantages of this method of automation are : - Improved sugar quality - Reduction of conglomerates by 50 to 60% - Reduction of colour from 0.30 St to 0.20 St. - Better output at centrifugals because of high uniformity of crystals. - Reduction of steam consumption because for this automatic control only C-sugar is required to be remelted, and A & B products are mixed as white sugar. DDS Equipment installed in Sanjeevani Sahakari Sakhar Karkhana, Maharashtra have realised some of these advantages and claim 15% reduction in C-boiling time and resultant energy saving.

Gadhinglaj Taluka Sahakari Sakhar Karkhana Ltd.

GADHINGLAJ

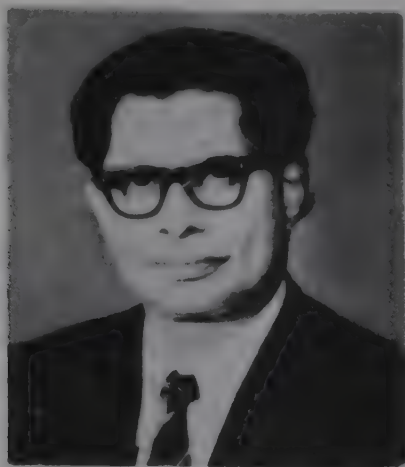
Tal. Gadhinglaj, Dist. Kolhapur (Maharashtra State)

SALIENT FEATURES

1. Manufacture of white crystal sugar
2. Maximum cane price to the cane growers
3. Maximum utilisation of crushing capacity
4. Ambitious CANE DEVELOPMENT PROGRAMME for the benefit of cane growers
5. Massive programme of charging Bore-wells is underway
6. Financial assistance is made available from Government scheme for purchase of share and cultivation of sugar cane to the marginal land holders of backward class.
7. Present capacity of 1250 TCD is being expanded to 2000 TCD from the ensuing season i.e. 1986-87 season.
8. Establishment of ultra modern distillery first of its kind in India of continuous fermentation process based on VOGELBUSCH multicont technology of Austria offered by Praj Counseltech Pvt. Ltd., Pune with incineration process by SPR ANNIHILATOR for effluent treatment ensuring Zero Pollution.
9. Under 20 Point Programme :
 - (a) Incentive to the family planning programme and
 - (b) Financial assistance to the cane growers for Bio-Gas Plants and
 - (c) Financial assistance to the landless backward class persons for the construction of quarters is made available.
10. AIM OF AROUND DEVELOPMENT OF GADHINGLAJ TALUKA

M. K. SAWANT
Managing Director

P. R. alias APPASAHEB NALAWADE
CHAIRMAN



SUGAR RESEARCH IN INDIA

Dr. N. A. Ramaiah

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Research is the back-bone of development and progress of any industry; it is so, more significantly for an industry of which the raw material is an agricultural commodity that is continually of varying nature. Raw material for sugar industry in a tropical country like India, is primarily sugarcane. The nature and composition of cane varies considerably with many agro-climatic factors, cultural practices adopted by cane growers etc. That varying nature of cane poses innumerable problems in processing cane, in controlling the quality of the end product viz., sugar, and even during commercial transactions. Keeping all these factors in view, the then Government of India appointed a Sugar Commission in 1920 to examine the possible magnitude of development of sugar industry in India and to work out the action to be taken for development of sugar industry on scientific lines. After a detailed study, the Sugar Commission observed that India enjoyed the best agro-climatic conditions for cultivation of cane; that the canes being grown at that time were not suitable for large scale cultivation for milling operations; and that intense research was needed for development of suitable types of sugarcane. The same had been endorsed by the Tariff Board in 1930. Incidentally, the Tariff Board was responsible for Government of India for enacting the Sugar Industry Protection Act, 1932, which gave protection for the Indian sugar industry for a period of 14 years and also gave tremendous impetus for development of sugar industry; this has been dealt with in detail in Chapter 1. Based on the recommenda-

tions of the Sugar Commission and the Tariff Board, the Imperial Government had rendered unforgettable and commendable service to Indian sugar industry by instituting research through the agencies of Imperial Council of Agriculture which attended to inter alia, the overall improvement of agriculture and sugarcane and sugar research in India.

2. Central Government Sugarcane and Sugar Research Organisations

2.1 The Imperial Government had established three very important sugar research organisations in the country :

- (i) Sugarcane Breeding Institute, Coimbatore.
- (ii) Indian Sugarcane Research Institute, Lucknow.
- (iii) Imperial Institute of Sugar Technology.

2.2 The objectives of these Institutes are specific; they, in all, attend to the totality of research and development needs of sugar industry.

3. Sugarcane Breeding Institute

3.1 The principal object of the Institute is to breed sugarcane varieties suitable for commercial cultivation and for industrial operations in different parts of the country. The commendable work of hybridisation i. e. to cross *Saccharum officinarum* varieties with robust wild plant like *Saccharum robustum* etc., carried out initially by Dr. C.A. Barbar and Dr. T.S. Venkataraman at the Institute, resulted in the development of world-

Dr. N.A. Ramaiah worked as the secretary of the Sugar Industry Enquiry Commission (commonly known as Bhargava Commission) in 1974. Dr. Ramaiah later worked as the Director, National Sugar Institute Kanpur upto 1981. He was then appointed as the Director of the Deccan Sugar Institute, Pune on a contractual assignment for five years for building the DSI; which work he completed in September, 1986.

Dr. Ramaiah has 40 years of research experience and has published 360 research papers in Indian and foreign scientific periodicals.

He was awarded the Sir S.S. Bhatnagar Memorial Award for his work on sugar. He had presented research papers at many ISSCT and ICUMSA conferences. He is a Director on the Board of World Sugar Research Organisation.

famous hybrid varieties, which brought revolution in sugarcane cultivation and which enabled sugar industry to grow in a large measure. The noble varieties of cane which have soft nature of rind and yet have higher sugar content, were found unsuitable for milling operations; these were replaced, by hybrid varieties. These have hard rind which made them less susceptible for attacks of wild jackals; and therefore, were amenable for profitable, commercial cultivation. At the same time they were found suitable for different milling operations. The development of hybrid varieties is the most significant contribution of the Coimbatore Breeding Institute and the same is largely responsible for development of sugar industry not only in India, but also in many other countries. These varieties from Coimbatore, commonly known as Co varieties, have become world famous and are in use in different countries. The details of the Co varieties which are in use in other countries have been given in Chapter I.

3.2 The breeding programme is carried out mainly under the aegis of the Sugarcane Breeding Institute, Coimbatore and here, two main approaches are adopted:

(A) Crosses are made and the selection of the progeny is carried out which lasts over 3 to 4 years. This selection leads to evaluation of 10 to 20, sometimes, more geno-types which are sent to various sugarcane growing States in the country to carry out further selection. Selection in the States takes nearly 6 to 8 years. Varieties evolved by this procedure are termed as 'Co' varieties.

(B) The fluff (hybrid seed) of crosses made at Coimbatore is supplied to various States to carry out the selection of the geno-types in various agro-climatic zones, where the varieties are to be released. The selection and evaluation of a variety in these States is carried out for a period of 6 to 8 years. The varieties obtained in State research stations are referred to differently; the symbol of the research station is appended to the term, Co; thus the name 'CoS' referring to Coimbatore Shahjahanpur variety, 'CoJ' Coimbatore Jullundur variety, etc.

3.3 The following are the State Sugarcane research centres where the fluff from the Coimbatore Institute is employed for development of varieties suitable for the local areas.

State Sugarcane Research

Institutions

(a) Andhra Pradesh

- (i) Sugarcane Research Station, Anakapalle, Dist. Visakhapatnam
- (ii) Sugarcane Research Station, Rudrur, Bodhan, Dist. Nizamabad

(b) Assam

- (i) Sugarcane Research Station, Jorhat
- (ii) Sugarcane Research-cum-Multiplication Station, Burialikson

(c) Bihar

- (i) Sugarcane Research Station, Pusa
- (ii) Regional Agricultural Research Station, Patna

(d) Gujarat

- (i) Sugarcane Research Station, Kodinar
- (ii) Agricultural Research Station, Vyara
- (iii) Agricultural Research Station, Jamnagar
- (d) Sugarcane Research Sub-Station, Navasari; Valsad
- (v) Sugarcane Research Station, Junagad

(e) Haryana

- (i) Sugarcane Research Sub-Station, Jagdhari, Ambala
- (ii) Sugarcane Research Station, Hissar

(f) Karnataka

- (i) Agricultural Research Station, Hebbal, Bangalore
- (ii) Sugarcane Research Station, Mandya
- (iii) Regional Sugarcane Research Station, Gangavati
- (iv) Regional Sugarcane Research Station, Sankeshwar

(g) Madhya Pradesh

- (i) Sugarcane Research Station, Sehore, Bhopal
- (ii) Sugarcane Research Station, Dhara, Gwalior
- (iii) Sugarcane Research Station, Ratlam

(h) Maharashtra

- (i) Sugarcane Research Station, Padegaon
- (ii) Regional Sugarcane Research Station, Kolhapur
- (iii) Sugarcane Research Sub-Station, Akulj
- (iv) Sugarcane Research Sub-Station, Deolali
- (v) Sugarcane Research Sub-Station, Lakhmanpur
- (vi) Sugarcane Research Sub-Station, Kopergaon

(i) Orissa

- (i) Sugarcane Research Station, Bhuvaneshwar
- (ii) Sugarcane Sub-Station, Rayagada, Koraput

(j) Punjab

- (i) Sugarcane Research Station, Jullundur
- (ii) Sugarcane Sub-Station, Gurdaspur
- (iii) Sugarcane Sub-Station, Kheri
- (iv) Sugarcane Sub-Station, Ludhiana

(k) Rajasthan

- (i) Sugarcane Research Station, Kota
- (ii) Sugarcane Research Station, Sriganganagar
- (iii) Sugarcane Research Station, Udaipur

(l) Tamil Nadu

- (i) Central Sugarcane Research Station, Cuddalore
- (ii) Sugarcane Research Station, Gudiyattam
- (iii) Sugarcane Research Sub-Station, Malalathur

(m) Uttar Pradesh

- (i) Sugarcane Research Station, Shahjahanpur
- (ii) Sugarcane Research Sub-Station, Muzaffarnagar
- (iii) Sugarcane Research Sub-Station, Gorakhpur
- (iv) Sugarcane Research Sub-Station, Golagokaranath
- (v) Tarai Sugarcane Research Centre, Pantnagar
- (vi) Government Farm Ghaphraghat, Baharaiach
- (vii) Sugarcane Research Sub-Station, Lakhimpur
- (viii) Sugarcane Research Sub-Station, Kashipur
- (ix) Sugarcane Research Sub-Station, Seorahi.

3.4 As mentioned earlier in Chapter 1, the State research stations or centres grow the approved variety of cane in large quantities in the farms attached thereto and issue the cane grown for commercial cultivation. Though this is the primary object of these regional research stations/centres, some of these centres have carried out epoch making research work. The same is due to the keen devotion and ingenuity of research personnel working in the centres. It is not possible to present a detailed resume of these findings. Suffice it to mention a few examples. The commendable work done at Jallundur Station by Dr. R. S. Kanwar in developing a new variety CoJ 64 deserves a special mention. The release of CoJ 64 about a decade back in the States of Punjab and Haryana has completely changed the history of sugar industry in these two States. Punjab and Haryana have earlier been branded as the States where the establishment of sugar industry was of no avail, as the recoveries were in the range of 8.0 to 9.0, and the cost of production of sugar was very high. Now after release of CoJ 64, the recoveries are far higher than 10.0; the same has completely changed the economic situation of sugar industry in Punjab and Haryana. Similarly, Tamil Nadu which used to have the lowest recovery among all the States in the country, is now benefited by the release of a variety CoC 679 Cuddalur.

3.5 Coimbatore Institute developed novel methods of breeding techniques - like recurrent selection with high sucrose varieties like Co 1148, Co 1158, Co 997,

Co 7717 and these were made available to different parts of the country. It also developed short duration varieties of about 8 months' duration, so that multiple cropping could be had for increasing productivity. One significant field that SBI is nowadays engaged in is the technique of tissue culture. In this technique, a small piece of tissue or developing leaf or stem segment is kept in a nutrient medium for about 10-15 days. A mass of cells grows which is separated into segments and grown in media. When these are exposed to artificial light minute sugarcane plants with all characteristics of the parent body are obtained.

3.6 This tissue culture technique being developed at Coimbatore Institute not only reduces time required for developing varieties, but helps to evolve novel techniques for development of disease resistance.

3.7 The Sugarcane Breeding Institute in collaboration with the Tamil Nadu Agricultural University conducts M. Tech. (Sugarcane Development) course. For the first time, this course was started at DSI also (vide infra) and is of considerable significance to fill in the gap of non-availability of trained sugarcane development officers.

3.8 This Institute functions under the administrative control of Indian Council of Agricultural Research in the Ministry of Agriculture, Government of India and is now headed by Dr. Mohan Naidu, a distinguishing research worker, who has brought laurels to the Institute.

4. Indian Institute of Sugarcane Research, Kanpur

4.1 This Institute has done remarkable, commendable research on extension work and on the development of engineering devices for cultivation of cane. These studies have helped not only the quality of cane produced but also the yield of cane in different parts of the country. The Institute conducts coordination projects, in different areas with the assistance of Indian Council of Agriculture Research, and different sugar factories, brought this research to actual field; and helped in bridging the often referred to gap between research organisations and the fields.

4.2 The Institute conducts short-time courses on modern techniques for cane development staff of sugar factories and is now headed by Dr. Kishan Singh a distinguished cane pathologist.

5. National Sugar Institute, Kanpur

5.1 The technological institute at Kanpur, established in 1935, under the name of Imperial Institute of Sugar Technology and now being designated as National Sugar

Institute, had carried out indeed commendable and laudable work in improving technical and engineering aspects of sugar industry. The functions of this Institute are three fold :

- (i) To carry out research on technological and engineering aspects relating to sugar industry.
- (ii) To render technical advice to sugar factories for improving their efficiency of operations or performance.
- (iii) To train candidates in different disciplines of sugar and allied industries.

5.2 In the research field, the contributions of this Institute are innumerable; the notable are : efficient cane preparatory devices, improved milling performance, designing of continuous clarifier for sulphitation of cane juice - (the most significant contribution to the sugar world, but for the NSI design of continuous sulphitor). Expansion of sugar factories would not have been possible at all but for the evolved measures for steam economy through vapour bleeding techniques from different bodies in evaporators, development of efficient condensation systems, boiling and curing techniques, etc. etc. The countless research innovations from this Institute are largely responsible for the commendable progress which the Indian sugar industry has achieved over the last 5 decades. Today, Indian technology for production of plantation white sugar ranks the foremost in the world. The sugar produced by Indian sugar industry is almost equal to refined sugar; the colour of Indian plantation white sugar is around 60-80 ICUMSA units, when compared to the standard limit of maximum 50 ICUMSA units for refined sugar. The work done at this Institute on exhaustibility of molasses is indeed praiseworthy.

5.3 The most significant and memorable contribution of the National Sugar Institute is training and making available personnel to man the sugar industry. Prior to 1950's, many of the sugar factories used to have foreign technicians; it is most gratifying to point out that because of the NSI, not a single factory in India now employs any foreigner either for running their unit or for any advisory purpose. On the other hand, technicians trained at NSI are working in various capacities in other countries to develop their sugar industry. Indian sugar technicians have worked and have been working on many an international organisation, like UNIDO, World Bank, etc. etc. for rendering technical advice. The sugar analytical technique and sugar accounting procedures invented and perfected at NSI have been responsible largely for the most efficient sugar manufacturing control systems being followed in India. To summarise, the supremacy that Indian sugar technology enjoys today in the world

is only due to the research and technological contributions from the National Sugar Institute at Kanpur.

5.4 The Institute has a 100 tcd Experimental Sugar Factory where sugar technicians undergo training and where new technological innovations are employed first, before the same are recommended for adoption by commercial sugar factories.

5.5 The Institute is now headed by Shri Ram Kumar, a noted sugar engineer. The Institute functions under the administrative control of the Department of Food, Ministry of Food & Civil Supplies. The research activities are monitored by an Advisory Board under the chairmanship of the Joint Secretary (Sugar) in the Department of Food.

6. Other Sugar Research

Organisations

6.1 With the enactment of Industries (Development & Regulation) Act, 1951 and Government of India's decision to encourage setting up of factories in cooperative sector, as pointed out in Chapter 1, a large number of sugar factories came up in a short period in the South. This increased the need of R & D requirements of factories in the South and the demands grew for a research institute in the South (and Deccan). Government of India had appointed a committee under the chairmanship of Shri P. R. Ramkrishnan, (the then M. P.) to examine the issue. The Committee in 1967 suggested that an institute similar to the one at Kanpur should be set up to attend to R & D requirement of factories in the South (& Deccan).

7. The Deccan Sugar Institute,

Pune

7.1 In 1975, the cane growers of cooperative factories in Maharashtra resolved to set up an institute at Pune and to finance the same by contributing Rs. 0.5 per quintal of cane crushed in their factories. The Deccan Sugar Institute, Pune was registered under Societies Registration Act 1860 and came into existence to serve the sugar industry. The objectives of the DSI have been almost the same as those of NSI, with emphasis on research in cane development and by-products utilisation. The Institute functions under the advice and control of Governing Council with the Chairmanship of Shri Vasantrao Dada Patil; Governor of Rajasthan, and 20 other members including Government representatives.

7.2 Since its inception, the Deccan Sugar Institute at Pune had carried commendable research work, particularly attending to the factors of utmost importance viz. its extension to the field. The Institute had

carried out investigations on the mode of harvesting, resulting in increase in yield and recovery. Crop planning with different, mid and late easily maturing varieties had been organised exceedingly well, so that the recovery of sugar in factories remained fairly the same throughout the season. Mutation techniques have been developed for inducing disease and pest resistance. Pest control devices had been extended to factories, pest and parasite control has been demonstrated successfully. A significant contribution from DSI has been development of a method of production of oxalic acid from waste cane trash. Immobilised yeast continuous fermentation techniques is being perfected. Energy that can be generated from distillery effluents had been computed and this work would be a valuable guide for entrepreneurs desirous of adopting modern techniques for distillery effluent treatment. On engineering and technological front, the DSI had rendered remarkable service in emphasising and working out of details for energy conservation by enumerating various steam saving devices, vapour bleeding techniques, by use of high pressure steam generation and utilisation. The Institute has developed a single method for estimation of SO₂ in sugars.

7.3 The DSI also trains candidates in different disciplines as at NSI but even in more disciplines such as use of computer techniques for sugar factory operations. Post-graduate sugarcane development course and post-graduate Instrument Engineers' course are of considerable importance in view of the fact that the industry is desirous to adopt automatic and microprocess or controlled techniques.

7.4 The Institute is now headed by Dr. D. G. Hapse, a reputed sugarcane specialist, devoted to extension work.

8. Somaiya Institute of Sugar

Research

8.1 A foresighted industrialist, Dr. S.K. Somaiya of Godavari Sugar Mills Ltd., who had been the President of Sugar Technologists' Association of India, realised the importance of industrial research and established a research centre in one of his sugar factories at Sameerwadi. This Institute is devoted to research on local problems related to sugarcane cultivation.

8.2 The Institute is headed by Dr. Narsimham, distinguished for his work on sugarcane crop planning.

9. Marhowrah Central

Laboratory

9.1 Under the control of British India Corporation, there are sugar factories operating in Eastern UP and Bihar. In one of their factories at Marhowrah,

Bihar, a central control analytical laboratory was established originally for the purpose of analysis of sugarcane products. When Shri S.C. Sharma a noted sugar technologist took over charge as Technical Adviser of the Cawnpore Sugar Works, the holding company of sugar factories of BIC, the Central Laboratory was utilised for research on sugarcane cultivation and sugar house products. The work done on the colouring matter of sugarcane and of sugar at this laboratory has received considerable acclaim.

10. South Indian Institute of Sugar

Technology

10.1 The Tamil Nadu Government had a proposal to set up a technological Institute and appointed one of the country's distinguished technologists, Shri A. P. Chinnaswamy as the special officer. The Institute was expected to be set up at Cuddalore. The office of the special officer is currently functioning in the office of the Director of Sugar, Madras. No progress in its establishment has, however, been achieved over the last 10 years.

11. Proposed Sugar Technological Institute

in Karnataka

11.1 Government of Karnataka is also considering to set up a Sugar Technological Institute, possibly near Hebbal in Karnataka and a committee has been constituted for working out its modalities. The Committee is expected to submit its report shortly.

12. Central Government's Proposal To Set Up

a Sugar Technological Institute in the South

12.1 It is understood that Government of India in the Department of Food is contemplating establishment of a sugar institute in the South in the VII Plan period. A committee under the chairmanship of Joint Secretary (Sugar), Department of Food made a preliminary study of various places in Andhra Pradesh, Tamil Nadu and Karnataka. The Government has perhaps yet to take decision on the matter.

13. Central Electronic Engineering

Research Institute

13.1 The Central Electronic Engineering Research Institute at Pilani under the Council of Scientific and Industrial Research is primarily devoted for research in electronic engineering. At the instance of the Electronic Commission, Government of India, New Delhi, the CEERI, Pilani, started from 1975 to do some development work in the sugar industry which involves many

processes that can be controlled by electronic devices. The CEERI collaborated with the National Sugar Institute, Kanpur, and developed valuable controls for the sugar industry. One system that has been taken up by sugar industry with useful results is the electronically controlled pH system for clarification of cane juice. The Institute at Pilani is carrying out further research on continuous operation of pan boiling, employing microprocessor techniques.

14. Sugar Factory Research

Laboratories

14.1 When Government of India in the Ministry of Finance had, since 1974, exempted expenditure incurred on R & D in industrial concerns from Income Tax, a number of sugar factories enriched their factory laboratories with equipment and personnel and devoted attention for research particularly on problems related to their own factories. It is praiseworthy to point out that with the advent of sugar factories paying attention to industrial problems, very useful results were obtained.

14.2 In some sugar factories where distinguished and research minded technicians worked, very commendable and useful research has been done and research schools have been developed. Notable of such groups are two : one headed by Late Shri S. N. Gundurao at Ravalgaon, and the other by Shri J. P. Mukherji at Walchandnagar. The work done on exhaustibility of molasses and clarification of cane juice by Gundurao and his associates has acquired international acclaim. The famous Gundurao formula for reduced boiling house recovery is being adopted in other countries too. While working at Ravalgaon, Gundurao designed a candy crystalliser. The remarkable sugar equipmental design work done by Mukherji is largely responsible for India's self reliance in the sugar engineering field in India. He provided commendable foundation to the sugar engineering industry in India. The excellent workshop at Walchandnagar is a great tribute to his proficiency in and devotion to sugar engineering.

14.3 Some of the disciples of Gundurao and Mukherji have become reputed research workers and set up research centres at other places; for example, Shri D. P. Kulkarni, a disciple of Gundurao, when shifted to Phaltan Sugar Works, had established a research centre and carried out notable work on demineralisation of cane juice and working out efficiencies of active carbon etc.

15. Research and Development Contributions

by Some Technicians

15.1 Large number of persons associated or not

with any research organisation, have made significant contributions by way of new innovations or developments for sugar industry. It needs volumes to enumerate the findings of all the workers and even to present a resume of all the results. Limitations of the space available for this article do not permit any exhaustive review; reference has to be made to some of the geniuses because of whose ingenuity and pursuit, the sugar industry has immensely benefited. The author is quite aware that by this attempt displeasure of many and recommendations of few are accruable. Nevertheless, reference to significant contributors is worth it and is made with apologies for omissions.

15.2 Dr. K. S. G. Doss

Dr. Doss had been with the National Sugar Institute for quite a long time upto 1958, during which period and later, the author had the good fortune of being closely associated with. His devotion for research is unparalleled; he lives on research. He invented the most novel technique of electrical resistance reheating of massecuites which is being adopted in many factories in India and abroad. Because of power limitation and some equipmental design difficulties, he had to improve the system and therefore invented Transient heating system using hot water which is easily available in all factories. The transient heating of massecuits has revolutionary effect and most of the factories are now adopting this technique in sugar factories.

15.3 B. L. Mittal

Shri Mittal is another genius who has made contribution to the sugar industry of immense value. Though he is not directly associated with any research organisation, his brilliance has brought laurels to India and also led to developmental of industrial equipment. His formula for reduced boiling house recovery brought him the famous Murray Award. Mittal design of mono vertical crystalliser for treatment of final massecuites is indeed novel and is being used in many factories.

15.4 Mydur Anand

Shri Anand is another technologist with ingenious inventive ideas. His work of pinionless drive brought considerable recognition to Indian research workers; and is being used by Hugot in his factories in Reunion etc. When a paper on this subject was presented at the last ISSCT conference in Jakarta (1986) the same received a good amount of esteem and admiration. His design of continuous pan, which worked satisfactorily for the final massecuite boiling, at Ponni in Tamil Nadu is indeed a significant contribution.

15.5 S. P. Misra

Shri Misra, a noted sugar technologist, has

not been associated with any research organisation, but contributed well to sugar industry. His design of molasses conditioner is of great utility to sugar industry and is being used in almost all factories in India and in many factories of other countries.

15.6 A. P. Chinna Swamy

Shri Chinna Swamy of Tamil Nadu Sugar Directorate, a technologist and a chemical engineer of repute, did commendable work in demonstrating that molasses purity could be brought down as low as 23-24. A decade back many of the Tamil Nadu factories had been losing sugar heavily in molasses. Shri Chinna Swamy and his associates worked hard in applying theoretical knowledge on exhaustion of molasses and took advantage of the modern equipment for continuous cooling devices, efficient curing techniques, etc. and brought down the purity of molasses from 35-38 to 23-24: a remarkable achievement.

15.7 Dr. B. B. Paul

Dr. Paul, a sugar technologist, a chemical engineer and sugar equipment designer, has done laudable work for sugar industry. Recently he designed a condenser system for sugar factories, which reduces water and power consumption, while at the same time improving vacuum upto 27 inches.

Dr. Paul has carried out very useful work for distillery industry, for reducing the steam and power consumption.

15.8 N. K. Varshney

Shri Varshney working for the Khandsari industry, developed a novel and useful method for drying of bagasse. His NSI continuous Mill Wet Bagasse Dryer involves direct and indirect drying in two stages. By this system, the bagasse moisture has been brought down to 35-37%.

15.10 S. B. Bhad

An unassuming worker in sugar engineering field and a disciple of Shri J. P. Mukherji, Shri Bhad had recently designed a simplified system of tooth roller pressure feeder system, which without disturbing the layout of the existing mills could be incorporated and by which high crushing rates with improved mill extraction and reduced bagasse pol and moisture could be had. SSTRPF system is being used in a number of factories in Maharashtra and elsewhere.

15.10 It may be pointed out that many of distinguished persons mentioned above have contributed and influenced the development of sugar industry, and vindicated that research is not the privilege of only research organisations and could come from anywhere as a result of ingenuity and devotion.

16. Organisations for Extension of Research Results to Industry

16.1 There have been many comments to the effect that research often ends in the laboratories or after publication of a research paper. But the sugar industry in India has been immensely benefited by the commendable research extension work done by a few organisations like -

- (a) Sugar Technologists Association of India,
- (b) Deccan Sugar Technologists' Association,
- (c) South Indian Sugar Technologists Association,
- (d) Indian Sugar Mills Association,
- (e) National Federation of Cooperative Sugar Factories, etc.

16.2 These have been the prime organisations, in the country which are devoted to the progress of the sugar industry.

17. Sugar Technologists Association of India

17.1 Is an all-India organisation with sugarcane technicians, sugar processing technologists, engineers and others as members. Deccan Sugar Technologists' Association and South Indian Sugar Technologists Association are regional organisations, affiliated to Sugar Technologists Association of India. All these three Associations hold annual conventions where technical papers on recent developments in various disciplines of sugar industry, including byproduct industries, are presented and discussed. From time to time, seminars are also held where one specific subject relating to sugar industry is discussed threadbare. A significant and commendable feature of Indian sugar industry is that even the secrecy of any finding made by anyone, any innovation of minor or major importance is proudly presented at these conventions/seminars. The same, once presented by an investigator, is tried in sugar factories by others, to establish the advantage of the finding. The proven useful findings are adopted invariably, universally by all sugar factories for the benefit of the overall performance of sugar industry. When once an innovation is being examined in a factory, the management of the factory, instead of keeping the same secret as in most other industries, invite all technicians to visit their factory and see the results of the innovations. Free exchange of ideas at the conventions and seminars and the laudable encouragement of sugar factory management for trial and adoption of new concepts and innovations are largely responsible for the tremendous progress and development that sugar industry achieved over the last 5 decades.

17.2 The Indian Sugar Mills Association and the National Federation of Cooperative Sugar Factories Ltd. have rendered and are rendering commendable service to the sugar industry by collecting and collating statistical data on the performance of sugar factories all over the country every year and communicating the same to all concerned. The same had manifold beneficial effects, including providing guidance to technical personnel. These two organisations, while looking after primarily the policy matters and financial welfare of sugar industry, accord considerable encouragement for research and development.

17.3 All the above organisations and technical personnel take active part in the deliberations of triennial congresses of International Society of Sugarcane Technologists (ISSCT), held in different parts of the world. It is gratifying that every congress is attended by 40-50 Indian delegates from different disciplines including management. Participation in these conferences helps immensely through the extension and inflow of research innovations of other countries into Indian sugar industry.

17.4 Indian sugar technicians also participate in the conferences of International Commission for Uniform Methods of Sugar Analysis, held every four years in different parts of the world. A few analytical methods developed in India, such as estimation of calcium in sugar house products, determination of modulated reflectance values for determination of colour of sugar in solid state, etc. have received acclaim.

17.5 While discussing the extension of research results to the development and improvement of efficiency of sugar industry, one cannot but refer to the commendable efforts of Shri P. J. Manohar Rao; while working as the Additional Chief Director and later as the Chief Director in the Directorate of Sugar, Department of Food. He has made considerable efforts for extension of research work. Though he had no research facilities in the Ministry, he collected valuable information of research and of new innovation, relating to all disciplines of sugar industry not only of India but of other countries and communicated them in the form of circulars, sometimes as directive circulars, for all sugar factories for adopting and for obtaining progress and improvement in the performance of sugar factories. He did help immensely in importing new equipment for sugar industry for steam economy, for energy conservation, etc. etc. in sugar industry. Now working as the Managing Director, National Federation of Cooperative Sugar Factories, he added a new venture in the activities of the Federation, by conducting seminars on some important subjects for improvement of efficiency of sugar factories.

18. Government of India's Role and Help in Sugar Research and Development

18.1 Invariably the annual conventions of the STA are inaugurated by the Food Minister. At these conventions he extends the support of Government of India for research and development of the sugar industry. This offers unforgettable and invaluable impetus and encouragement to research workers in their endeavour for improvement of the efficiency of sugar industry.

18.2 Government of India gives invaluable encouragement by sponsoring large delegations to the international sugar conferences.

18.3 As has been mentioned earlier in this Directory (Chapter 1) Government had instituted Sugar Development Fund. From this Fund, financial assistance is being provided for research schemes submitted by organisations registered under Societies Regulation Act, 1960. For planned and time-bound sugarcane development work to be undertaken by sugar factories, Government provides laudable support and offers loans at a very nominal rate of interest. By February 1987, the Central Government had sanctioned loans totalling about Rs. 13.50 crores to more than 24 sugar factories for sugarcane development.

(A)	Joint Secretary (Sugar) Department of Food, Krishi Bhavan, New Delhi	Chairman
(B)	Director (ST), Directorate of Sugar, Krishi Bhavan, New Delhi	Member
(C)	Professor of Sugar Technology, National Sugar Institute, Kanpur	-do-
(D)	Director (TUD), Department of Science & Technology, New Delhi	-do-
(E)	Professor of Biochemical Engineering, Indian Institute of Technology, New Delhi	-do-
(F)	Director, Sugarcane Breeding Institute, Coimbatore	-do-
(G)	Director, Indian Institute of Sugarcane Research, Lucknow	-do-
(H)	Industrial Advisor, (Food & Fermentation Director), Directorate General of Technical Divn. New Delhi	-do-

- (I) Managing Director,
National Federation of Coop. Sugar
Factories Ltd
New Delhi -do-

18.4 The Government of India in Electronic Commission and in National Cooperative Development Council offers financial assistance to projects for research and extension work. Two such schemes are currently operative at the Deccan Sugar Institute.

18.5 The Development Council accords financial assistance for some schemes, which are of use for development of sugar industry. One such scheme operated during 1955-59, is B-heavy molasses clarification.

18.6 The Development Council is assisted by a Standing Research Advisory Committee. The present composition of the same, as given, Government of India Notification No. DCS/S-21/86/1240 dated 24th November 1986 from Department of Food & Civil Supplies, is as follows :

- (J) The President,
Indian Sugar Mills Association,
New Delhi -do-
- (K) Director,
Institute of Paper Technology,
Saharanpur, U. P. -do-
- (L) Scientist,
Council of Scientific & Industrial
Research,
New Delhi -do-
- (M) Director,
Deccan Sugar Institute, Pune -do-
- (N) Dr. N. A. Ramaiah,
14, Ocean View,
Visakhapatnam 530 003 (A. P.) -do-

19. CONCLUSION

19.1 The impact of research on industrial development is always slow and apparently unimpressive. It does not catch the public eye early, excepting in rare cases. If we examine the effect of research on the progress of sugar industry over the last four to five decades, we will find the same as startling and exhilarating. Results are indeed impressive. On sugarcane field the all-India average yields increased from 30.9 tonnes per hectare in 1930-31 to 60.0 tonnes in 1985-86,

a startling improvement in fact. The yields would have appeared much more impressive but for the deplorably low average yields in UP and Bihar. In these States, the low land holdings of poor cultivators and their inability to adopt required cultural practices for healthy cane cultivation result in these areas being below all-India averages.

19.2 Effective harvesting techniques increased yield of sugar content of cane. Poor cane preparatory devices had been replaced by efficient techniques which now give preparatory indices as high as 75-80 per cent, when compared with 40-45 per cent in early 1940s. The improvements in milling are indeed remarkable. On average, reduced mill extraction increased from 88-90% in 1930s to 94% in 1985-86; some factories have even recorded recently 97% reduced mill extraction. The steam consumption in sugar factories decreased considerably. In most of the factories inefficient steam-driven motive power had been replaced by turbine or electrical motion. The overall steam consumption decreased from over 60% to 48-50%. It is commendable that factories which have been consuming extra fuel worth lakhs of rupees, now save huge quantities of bagasse. Employing this saved bagasse, a few sugar factories have established paper factories. Development of byproduct industry in India is indeed praiseworthy. In this context, reference made by Shri H. K. L. Bhagat, Union Minister for Parliamentary Affairs, Food & Civil Supplies, in his Inaugural Address at the Silver Jubilee celebration of Gujarat Rajya Sahakari Khand Udyog Ltd., is significant. "Of late the profit centre in the sugar industry is gradually shifting from sugar to utilisation of by-products."

19.3 Improvement in the colour of Indian sugar is indeed praiseworthy. Sugar of ISS grade 18 and 19 was produced in 1940. Gradually by adopting efficient boiling techniques and curing devices, the colour of sugar has now become of ISS grade 29 and 30. In terms of ICUMSA units, the sugar now produced has colour in the range of 60-100 units. When compared with 200-250 ICUMSA units in 1940s. In some factories, sugar produced almost appears as if it is refined sugar.

19.4 Automation has become the keyword in sugar industry. Most of the operations have now become continuous and are tending to become automated.

19.5 Sugar research indeed paid good dividends to sugar industry.

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In the Interest and Happiness of All

**We wish Progress, Happiness and Prosperity
on the occasion of Deepavali
to the Members, Consumers, Well-wishers and Workers**

of

**SAHYADRI
Sahakari
Sakhar Karkhana Ltd.**

**Post Yeshwantnagar
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Gram : SAHYASAKHAR, Karad

**Tel Nos : Factory 2141, 2304
Karad : 2302, 3239**

**The Foremost Manufacturer of White, Granular Sugar
A Biostil Distillery with 45,000 LPD Capacity
is to be commissioned shortly**

**The establishment of SAHYADRI S. S. K. must be credited
to the Promotional Inspiration of the Revered
Shri YESHWANTRAO CHAVAN**

Our Projected Determination is :

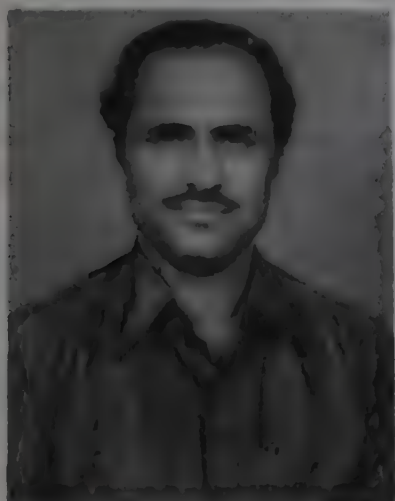
To increase the crushing capacity to 5000 MTD

To start Lift Irrigation Schemes

**G. S. CHAVAN
Managing Director**

**BHIKUNANA SALUNKHE
Vice-Chairman**

**P. D. PATIL
Chairman**



RECENT TECHNOLOGICAL ADVANCES IN SUGARCANE PRODUCTION FOR PROFIT

DR. D.G. HAPASE

Deccan Sugar Institute, Pune

World Sugar Balance

The 4th estimate of world sugar balance for 1985-86 was recently released by F.O.Litch GmbH. Production is now set up at 98,885,000 tonnes raw value against 100,127,000 tonnes in 1984-85 while consumption has increased to 100,313,000 tonnes in 1985-86 from 98,638,000 tonnes with the difference in imports and exports of 517,000 tonnes, against 1,488,000 tonnes a year earlier, the final stocks are reduced to 37,982,000 tonnes (37.86% of consumption) from 39,927,000 tonnes (40.48% of consumption), which shows that "although fundamentals have improved and are likely to be improved in 1986-87 season, the long term outlook for sugar is dim". Exporters will have to adjust to lower demand growth, which has already fallen close to population growth. Unless exporters keep a tight rein on production, another period of low prices may soon be upon us, probably even before the recovery has developed to its full potentialities.

World Sugar Prices

Ronald Duncan, Head of the World Bank's Commodity Studies told in a Commodity Seminar that the Bank expects world sugar prices to continue rising from last year's low. The sugar agreement daily price (f.o.b. at greater Caribbean ports) was around US \$ 154/t during 1986 as against US \$ 90/t in 1985. The price is forecast to rise to \$ 187 in calendar year 1987 to \$ 235 in 1988, to \$ 316 in 1989, to \$ 450 in 1990, to \$ 452 in 1995 and to \$ 525 in the year 2000, provided US and European sugar market restrictions remain in force. However, he also states that there will be strong fluctuations in prices and there could be another boom before the year 1987.

Asian Sugar Consumption

According to Wong Yi-Ting, Chairman of Taiwan Sugar Corporation, sugar demand is rising in all Asian nations except Japan; although growth in world sugar consumption is tailing off. In an address to 19th I.S.S.C.T. Congress at Jakarta, he said that world consumption

is expected to have risen during the previous 12 months by little more than 1%, the lowest for last 25 years. This rise contrasts with growth ranges averaging 5.2% in the 1950s, 3.2% in the 1960s, 2.2% in the 1970s and 2.0% in first half of 1980s. However, Asia is a bright spot with a 5.9% average growth rate of raw sugar consumption in first half of the 1980s. His estimates for sugar use in Asia 1985/86 would have been 30.5 million tonnes accounting for 31% of world sugar consumption and up from 29.9 million tonnes in 1984/85 and 22.9 million tonnes in 1980/81. Highest growth rates are in India and Pakistan where consumption rose by 10.6% and 11.5% respectively, over the past five years. Japan's raw sugar use decreased in the early 1980s following the introduction of high fructose syrup, with 1985/86 consumption estimated at 2.82 million tonnes against 2.88 million tonnes the year before. In Japan, consumption of its accounts for 20% of total sweetener consumption.

It is estimated that European beet sugar production could fall 3.7% to 29.9 million tonnes in 1986/87 according to F.O.Litch GmbH whose figures compare with the 1985/86 output of 31.1 million tonnes.

Indian Scene

Sugar production in the country has been erratic over the past six or seven years, and has largely moved in tandem with Government policies on cane pricing and control on supplies, that refused to come to terms with growers' problems. The result was that the country which had exported sugar over 90 lakh tonnes between 1957 and 1983, became net importer - 29 lakh tonnes of imports during the last three years.

The new sugar policy announced by Central Government on 11th December 1986 received warm welcome. The outstanding features of the policy are the advance announcements of the statutory minimum cane price for the next two seasons, the change in the ratio between levy and free sale sugar from 55:45 to 50:50 and licencing rules to prevent crowding of sugar units and uneconomic crushing capacities. So far all sugar policies were adhoc. This

policy seems to have been worked out after exhaustive thinking and study.

It is expected that by implementing this policy, production of sugar will go upto 7.7 to 8 million tonnes this year. The higher price which sugar mills will have to pay to growers is being off-set by an increase in the levy price from an average Rs.3.91 per kilo to about Rs.4.05. However, sugar made available through the public distribution system, will be costlier by five paise a kilo at Rs.4.85.

The increase in the levy price and the change in the ratio between levy and free sale sugar will place the sugar industry in a more comfortable position to put larger quantities in the free market, improve its realisation and curb deficit/sickness. Although the government has full control in releasing the quota for freesale.

Although it appears that the policy is quite cheerful, it still appears that it is incomplete from the point of view of the growers. The sugar production depends upon the production of quality cane and its timely harvest. The planting of sugarcane will depend upon the comparatively low cost of production, profit realisation of sugarcane vis-a-vis other cash crops like horticulture crops, vegetable crops and plantation crops. In Maharashtra, all these crops are becoming more competitive with sugarcane. Besides the money realisation is quite faster as compared to realisation of the total price of sugarcane.

Profit Realisation depends on

Thus, from the point of view of making more profit, following are major aspects :

1. The profitability of the cane farming,
2. Minimum manufacturing cost and desired realisation of profit by mills,
3. Approximate sugar price for the consumer.

For getting more profit from the sugarcane after it is received in the sugar factory, it is necessary to have encouragement for developing the sugar industry complex, such as, production of alcohol and alcohol based by-products, products based on molasses (cattle feed, etc.), by-products based on bagasse filter cake, etc. There is vast scope to have array of by-products useful in industry, energy, food, etc.

Efforts needed to increase yield/ha/month

For improving profitability, the farmer will have to adopt modern techniques which have accent on increasing sugarcane and sugar production per hectare per month with minimum inputs and buildup soil fertility. For considering this aspect, one will have to know the problems or constraints in the production of sugarcane at specified location. These problems and the possible solutions are summarised here.

1. Understand the Sugarcane Plant (Crop) and its requirement

Sugarcane is the most efficient solar energy converter among all other sugar or starch producing crops. Although from the point of view of yield of sugar or ethanol/MT of raw material, a few crops may surpass sugarcane; considering energy balance sugarcane remains unbeaten or supreme efficient crop. However, to harness maximum returns from this crop one has to understand its physiology and impact of different environmental factors on each and every growth attribute of this crop.

Although there are many aspects which need detailed discussions, I would like to consider only most limiting factors and recent advances in production technology to overcome them.

1. Irrigation

It is the most important limiting factor. The adverse effect of water shortage, particularly during grand growth stage is more severe. Our experience is that the severe water stress during summer months (45 days irrigation interval) leads to reduction of sugar and cane yield upto 40%. Besides, water stress leads the perpetuation of pests like scale, mealy bug, white grub and termites, etc. Water stress weakens the plants and hence it becomes more susceptible to disease. Incidence of smut is more severe in water stress fields than normal.

Excess irrigation also leads to many problems like water logging, salinity and over-all effect in poor growth, yield as well as proneness to diseases and pests.

The present irrigation practices have many draw backs. We will have to adopt the sprinkler, subsoil or drip irrigation. Drip irrigation seems most efficient. However, the efforts need for reduction in costs. Biwall system of drip irrigation has emerged as the best.

Drainage seems important in heavy rainfall areas, low lying areas and particularly heavy soils.

2. Soil Fertility Management

The total integrated consideration of soil physical, chemical and biological properties, is most important for harvesting a bountiful crop. Not much attention is given to this aspect. The availability and uptake of nutrients depends upon all these types of fertilities. Compost plays an important role in achieving desired level of soil physical and biological fertility. It also greatly influences the availability of nutrients (activity) and not the total storage (capacity) of nutrients in the soil.

Fertilade, a recent introduction in our country is a promising chemical soil amender. It improves the arrangement of the soil particles and thereby

soil physical properties, which in turn improves root growth and its activities. Application of fertiliser at appropriate stage of crop helps to improve yield of sugar and sugarcane to a great extent.

The biological fertility can be improved by using right type of efficient strain of Azatobacter. Azola also shows promise in water logged soil. Using biofertilizers combined with FYM and micro nutrients has best additive effect. Attention is needed to work out the schedule of micronutrients for sugarcane.

The physical fertility of soil is influenced by cultural practices and cropping patterns or systems. Legumes as intercrop/rotational crop, and working soils at appropriate moisture level help to keep up the physical fertility at a desired level.

3. Nutrition

Balance and timely fertilizer use has tremendous effect on qualitative and quantitative yield. Generally, farmers use high amount of Nitrogen, preplanting dose of NPK is neglected. All the nutrients added through FYM or compost will have better effect.

4. Plant Protection

Whatever is gained through cultural practices, variety, etc. need to be saved from the vagaries of pests and diseases. There should be vigilance. Timely action in combating pests is remunerative. Diseases can be kept to a low level by adopting field sanitation and three tier system of seed programme involving heat therapy treatment. For vigilance or supervision planting method needs to be modified.

5. Planting Method and Plant Population

Sugarcane is C_4 plant. It responds to light intensity and higher temperature. Closer spacing leads to tiller death. Wider spacing by adopting paired planting seems promising. It has advantages in irrigation, pest management and weed control.

6. Farming System Approach

Production of sugarcane should also be considered from Farming system in point of view to give attention to soil fertility and overall economy for the farmer. The size of holding is generally very small. The need of farming system is to be considered. Hence rotation/inter cropping systems with full details of variety cultivation practices will have to be worked out and the same should be effectively transferred to the farmer.

7. Transfer of Technology

Our farmers can not afford to have experiments on their farms since they have very small holding. Those who are responsible for transfer of technology, should be confident about the usefulness of the same

and should be in position to convince the merits to the farmer. To make transfer of technology effective, it should be told in easy understandable language, with appropriate audio visual/result demonstrations.

8. Finance/Credit

For adopting a technology, if farmer needs financial help, etc. it should be available readily with minimum interest.

9. Guarantee for sale of the Farm Produce and Insurance

The benefits of the adoption of technology will depend on the harvesting of the crop at right time. The delay in harvesting leads to great losses. Further under the natural vagaries, there are tremendous losses in crop. His crop should have the insurance so that he can sustain such type of losses.

Thus we must have an integrated approach for production of sugarcane in farming systems and at factory-mill level there should be a complex of various units, economically and technically well balanced to harness maximum profits with minimum input.

Reference

1. F.O. Litch's International Sugar Report, Vol. 118(29) Oct. 1986.

★★★

SUGAR

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Marching towards the Socio-Economic
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D. L. Sidam
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ASHOK SAHAKARI SAKHAR KARKHANA
LTD., ASHOKNAGAR

Tal. Shrirampur, Dist. Ahmednagar
(Maharashtra)

Table 1
Area, Production and Productivity of Sugar and
Sugarcane in Maharashtra & India
1975-76 to 1985-86

Details / Year	75-76	76-77	77-78	78-79	79-80	80-81	81-82	82-83	83-84	84-85	85-86	Average	% to India
Maharashtra													
Area (Lakh/ha)	2.12	2.41	2.46	2.44	2.22	2.56	2.97	3.26	2.94	2.92	2.65	2.63	9.13
	(7.68)	(8.40)	(7.81)	(7.90)	(8.50)	(9.59)	(9.31)	(9.70)	(9.28)	(9.89)	(9.26)		
Sugarcane Production (Lakh Tonnes)	188.7	241.9	223.2	296.0	190.2	235.9	287.8	313.6	265.5	263.7	237.1	249.42	15.23
Sugarcane Crushed (Lakh Tonnes)	142.6	143.8	192.4	192.3	131.5	188.8	282.9	276.2	197.0	208.5	213.1	197.19	32.76
Sugarcane Yield (MT/ha)	89.1	89.2	94.8	92.1	89.3	92.3	96.9	96.3	90.3	90.1	89.4	91.8	167.7
Sugarcane Productivity / Mt /Month/ha)	7.43	7.43	7.90	7.67	7.44	7.69	8.07	8.20	7.50	7.51	7.45	7.65	167.8
Sugar Production (Lakh T)	15.06	15.59	20.95	21.05	13.94	20.85	30.26	30.25	19.93	23.11	23.89	21.44	37.16
	(37.68)	(32.21)	(32.04)	(36.04)	(36.13)	(40.51)	(35.86)	(36.75)	(33.68)	(37.61)	(34.05)		
Percent Sugar Recovery	11.2	10.84	10.89	10.95	10.60	11.04	10.68	10.95	11.13	11.08	11.20	10.96	110.48
India													
Area (Lakh/ha)	27.6	28.7	31.5	30.9	26.1	26.7	21.9	33.6	31.7	29.5	28.6	28.8	
Sugarcane Production (Lakh Tonnes)	1460	1530	1770	1517	1288	1505	1864	1895	1770	1703	1717	1638.01	
Sugarcane Crushed (Lakh Tonnes)	418.8	448.2	673.3	597.2	390.5	515.8	873.4	827.0	590.2	600.9	685.5	601.90	
Sugarcane Yield (MT/ha)	50.9	53.4	56.2	49.1	49.4	57.8	55.4	56.4	55.9	57.8	60.0	54.75	
Sugarcane Productivity / (MT /Month/ha)	4.24	4.45	4.68	4.09	4.11	4.82	4.62	4.70	4.65	4.78	5.0	4.56	
Sugar Production (Lakh T)	42.62	48.40	64.61	58.41	38.58	51.48	84.37	82.29	59.17	61.44	70.16	60.14	
Percent Sugar Recovery	9.83	9.92	9.61	9.78	9.88	9.98	9.66	9.95	10.02	10.22	10.23	9.92	

Table 2

Tropical and Subtropical Energy Crops : Composition, Productivity and Yield of Ethanol; mean values

(Source : da ROSA OITICICA 1979)

Crop	Composition		Plant cycle (months)	Agricultural Productivity		Yield of Ethanol		
	Sugars	Starch		(t/ha)	(t/ha'a)	(l/ha)	(l/ha'a)	(l/ha' month)
A. Sugary								
Sugarcane	15.0	-	12	70.0	60.0	5,250	4,500	375
Sweet Sorghum	14.3	-	4	32.5	32.5	2,460	2,400	615
B. Starchy								
Potato	2.0	12.0	4	12.0	12.0	900	900	225
Sweet Potato	3.0	21.0	6	20.0	20.0	2,500	2,500	415
Cassava	3.0	30.0	22	25.0	12.5	4,500	2,250	190
Sorghum	1.5	60.0	4	3.0	3.0	1,020	1,020	225

Table 3

Energy Balance of Ethanol Production from Sugar Cane,

Sweet Sorghum and Cassava

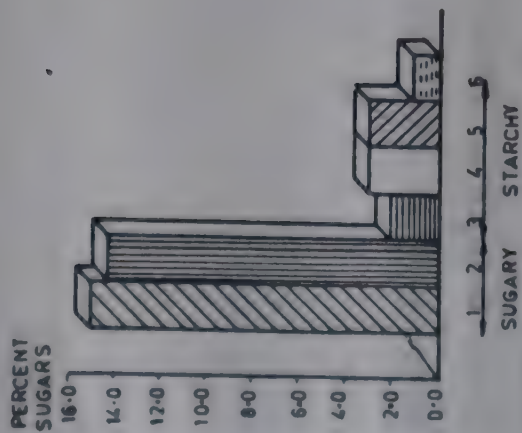
(Source : ROQUE de OLIVEIRA 1978)

Crop	Ethanol Production		alcohol	Produced residues	Energy Total (Mcal/ha a)	Consumed		Total	Balance
	(l/t)	(l/ha)				Agricul- tural phase	Industrial phase		
Sugarcane	66	4,752	18,747	17,550	36,297	4,226	10,814	15,040 +	21,257
Sweet Sorghum	-	3,775	19,856	11,830	31,686	4,667	11,883	16,550 +	15,136
Cassava	174	5,046	13,271	-	13,271	2,753	8,883	11,636 +	1,635
Cassava *	174	5,046	13,271	9,112	22,283	4,042	8,983	12,925 +	9,358

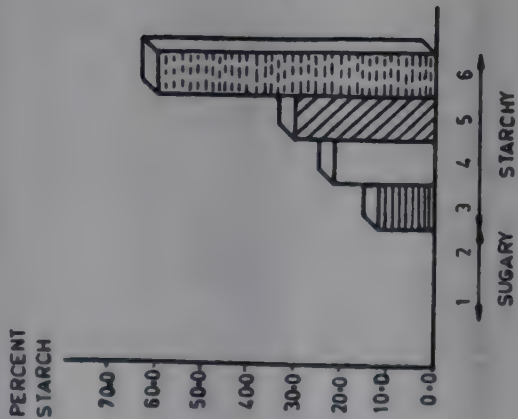
* Calculation according to PIMENTEL 1980

1-COMPOSITION

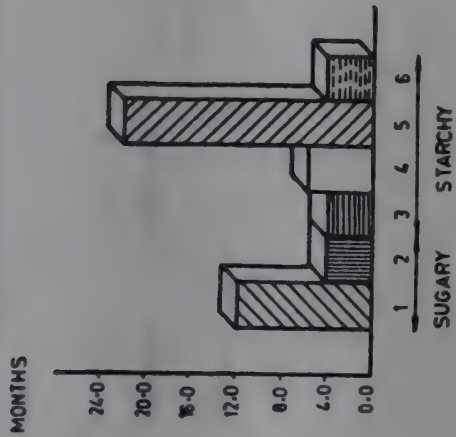
A - SUGAR (PERCENT)



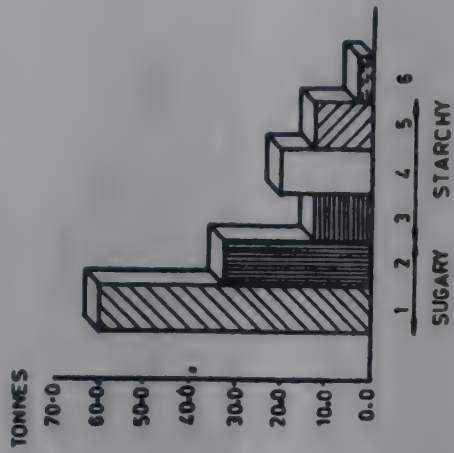
B - STARCH (PERCENT)



2-PLANT CYCLE

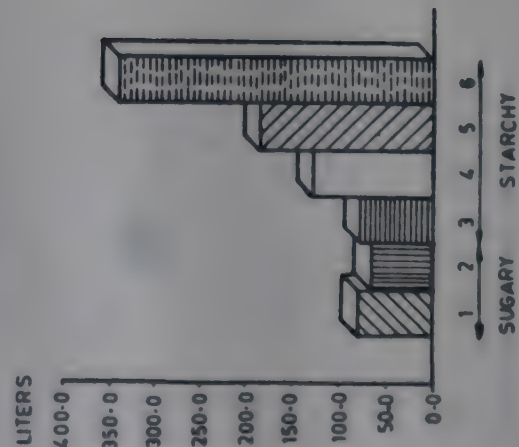


3-AGRICULTURAL PRODUCTION (TONNES PER HECTARE PER ANNUM)

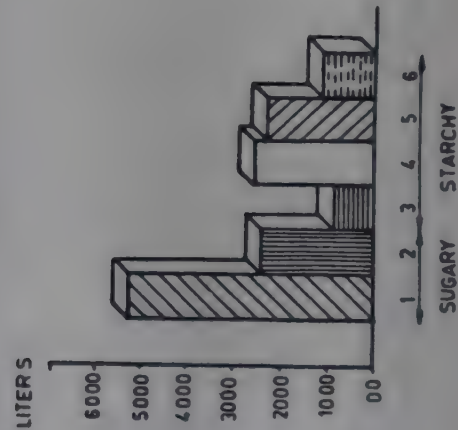


4-YIELD OF ETHENOL

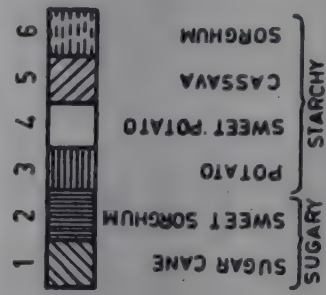
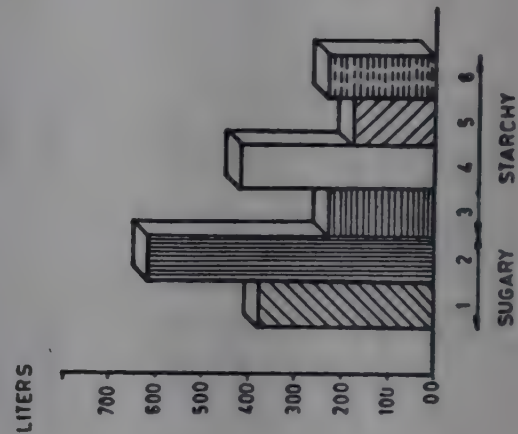
A - LITERS PER TONNE



B - LITERS PER HECTARE



C - LITERS PER HECTARE PER MONTH

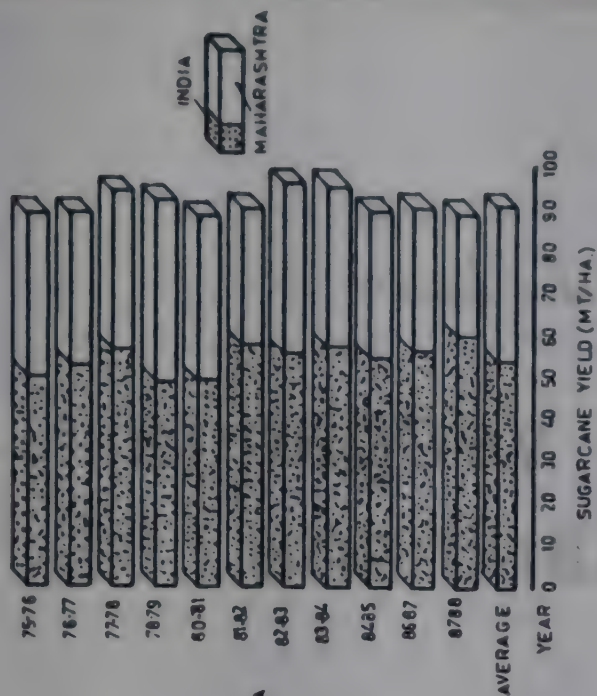


TROPICAL AND SUBTROPICAL CROPS. COMPOSITION, PRODUCTIVITY AND YIELD OF ETHENOL

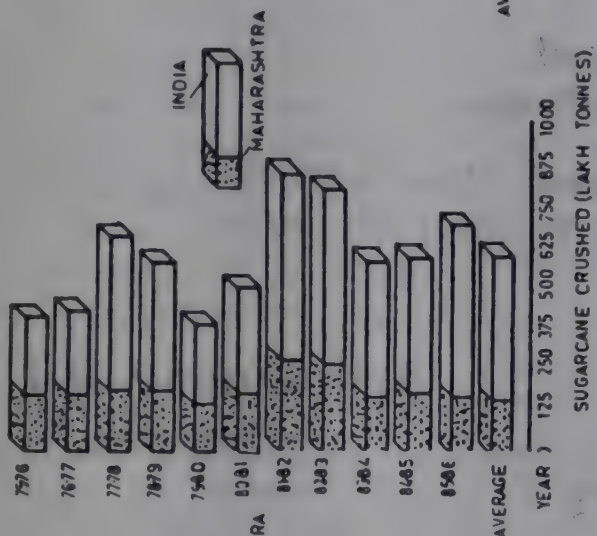
SOURCE - DA ROSA OTICICA - 1979

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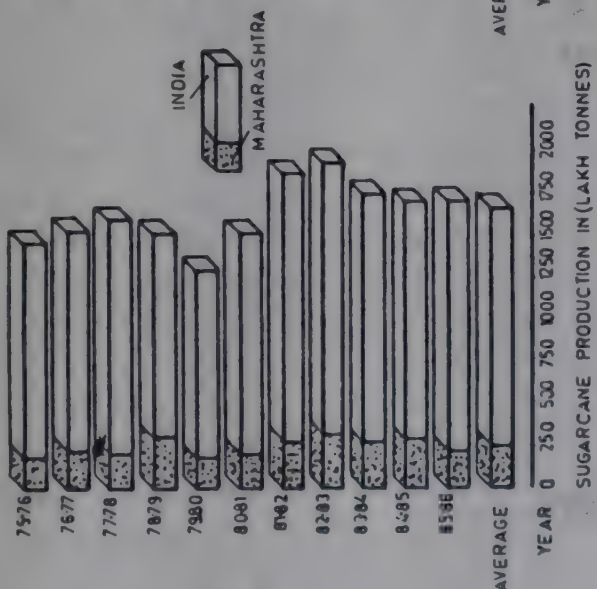
SUGARCANE YIELD
(MT/HA)



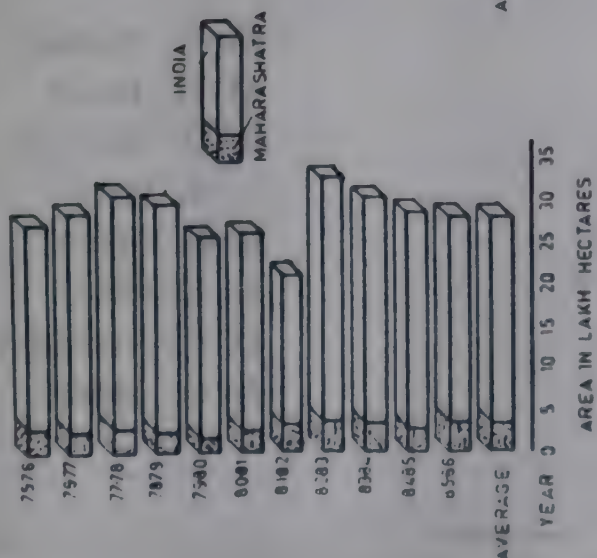
SUGARCANE CRUSHED



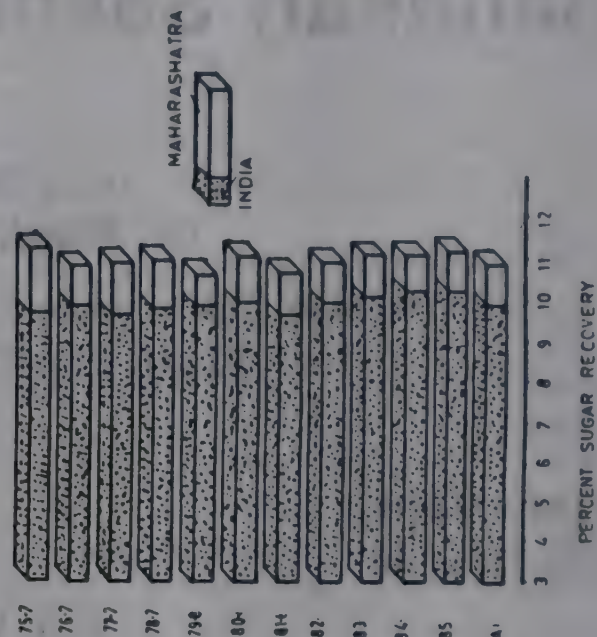
SUGARCANE PRODUCTION
(LAKH TONNES)



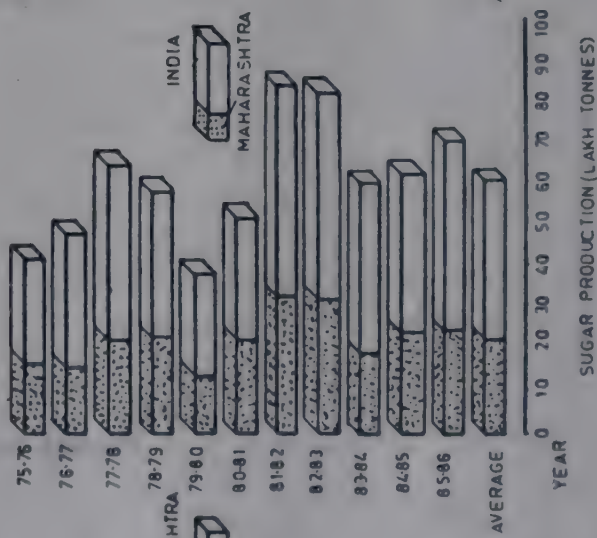
AREA
(LAKH HECTARES)



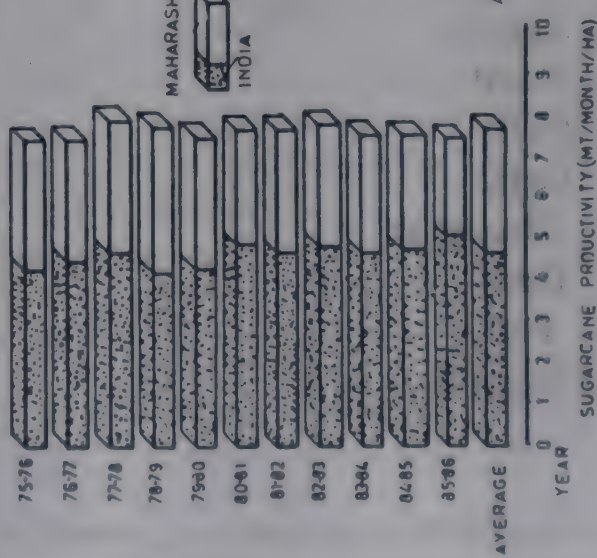
PERCENT SUGAR RECOVERY



SUGAR PRODUCTION
(LAKH/TONNES)



SUGARCANE PRODUCTIVITY
(MT/MONTH/HA)



AREA, PRODUCTION AND PRODUCTIVITY
OF SUGAR AND SUGARCANE IN
MAHARASHTRA AND INDIA
(1975-76 TO 1985-86)

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THE SUGAR SCENE IN INDIA

DR. N. MAHALINGAM

Chairman, Sakthi Sugars Ltd., Coimbatore

The Sugar Industry in our country has the unique distinction of not only being agro-based but also of having a close relationship with people in rural areas where they are located. Agro-based industries in general have special relevance to Third World countries but in the case of the sugar industry here it is more relevant because sugar factories have all along tended to promote rural development in their areas of operations. In fact much has been done by a majority of the sugar factories towards rural development without prompting from outside agencies even as a measure of enlightened self interest because their prosperity depends on the prosperity of the cane farmers as also the people living in their areas.

India is the World's largest sugarcane producer but its share in cane sugar output is proportionately much less. This is because in this country there is not only one economy for sugar but three different economies, Sugar, Khandasari and Gur. Sugarcane is common material for all these sweeteners and the supply to sugar factories of cane is only one-third. The Gur and Khandasari industries in fact affect the regular supply of cane to sugar factories and this is one of the main reasons for the variations in output of cane sugar. The sugar industry gets the worst of the bargain in both years of surplus and shortage of cane supply. It has to go to the rescue of cane farmers during periods of plenty, but in years of low production they are unable to compete with the Gur or Khandasari sector, in the absence of proper controls or regulations on these alternate sweeteners. That also accounts for the fact that cane sugar output is much less in our country compared to the quantity of cane grown in the country.

To what extent Government policies have helped the industry to grow or have fettered the growth of the industry is the subject of this article. I would first like to reproduce here the observations in our Sixth Plan document regarding the sugar industry which hold good even now.

Sugar :

"As the World's largest producer of sugarcane, the country has considerable potential for the development of sugar industry to meet domestic demand

as well as exports The wide fluctuations in sugarcane production result in periodic scarcity and surplus in sugar causing distress to the farmers, sugar industry and the consumer. This calls for a rational policy of pricing of sugarcane and sugar as also the other sweetening agents like Gur and Khandasari". These observations point out the need for a rational policy in the pricing of sugarcane and sugar and also other sweeteners.

While it may not be feasible to eliminate fluctuations in sugar output, with realistic and appropriate policy embracing all sweetening agents, it should be possible to minimise fluctuations in sugar production. In spite of the fact that these alternate sweeteners result in loss in extraction, loss of bagasse for paper pulp, have poor shelf life and have only a dubious employment potential, they are considered as the traditional sector in the sugar economy which cannot be disturbed through Government intervention, but it is forgotten that these different economies inter-act violently and the unfettered freedom for commercial manufacturers of both Khandasari and Sugar is one of the important reasons for variations in sugar production. So I think it is high time that an in depth study should be made how best to bring these sweeteners under the umbrella of a uniform policy and also to lessen the disparities in duties levied on these alternate sweetening agents. The general approach could be something akin to Government's approach towards textiles, where there are separate sectors like mills, powerlooms and handlooms. The unorganised sectors are not allowed to violate locational guidelines. At least to begin with, the following measures could be introduced, viz. Khandasari units should not be allowed in factory areas, power crushers for production of jaggery should be licensed; the policy of partial control can be extended to Khandasari and disparities in excise duty minimised, as also realisations from molasses.

Of course sugar cannot supplant the economies of jaggery and gur, but it is certainly possible to divert portions of cane now being utilised for gur and khandasari for production of sugar, considering that cane sugar absorbs at present only about 40% of the total cane grown in our country.

Dual pricing of sugar served its object very well in the earlier years, but gradually the system of political state advised prices has come to stay and the centre is not able to enforce any discipline in the matter of state advised prices.

Now they are far above the paying capacity of the factories. For quite sometime (for more than five years) the main object was to keep sugar prices, under the public distribution scheme, very low and it was actually the main plank of Government's policy from 1974-75 to 1980-81 and this has resulted in accumulated losses for the industry. In fact the methodology adopted during this period for arriving at levy sugar prices encouraged the practice of state advised cane prices being fixed at higher levels as such cane prices were built into levy price of sugar. It is only since 1980-81 that the Government have accepted the position that the minimum statutory cane price should be the basis for levy sugar prices but, in the meantime, considerable sickness had spread into the industry. But what is more, Government have not been able to even now to enforce the basic principle of profit sharing between the cane grower and the factory which was recommended by the Bhargava Commission, accepted by Parliament and embodied in the Statute Book - i.e. under Clause 5-A of the Sugarcane Control Order. This has been ignored. So the excess realisations from sugar sales are not shared with the sugar industry, but are mopped up by the cane grower fully under the present practice of high state advised cane prices announced by the state and based on extra-economic considerations.

All along as compared with other industries, the sugar industry has had a low profitability, the average gross return earned by the sugar industry has also fallen short of the figures of gross profit percentage of the total capital employed in various industries. The profitability and the other ratios of the sugar industry as compared with the other industries is shown as an Annexure I which will reveal at a glance that at no time the sugar industry has made even normal profits (as compared with other industries) whereas, by any logic, a high risk industry like sugar dealing in perishable raw materials deserves larger profits, comparatively.

So, while partial control (dual pricing) gave the industry manoeuvrability in regard to payment of cane price in the beginning, the gap between the minimum cane price is being put forward as an argument by the cane farmer to demand still higher cane prices maintaining the same gap as before between the statutory minimum and state advised prices. The Government of India have of course realised at long last, the utter inadequacy of minimum cane prices announced upto 1983-84 to meet the operational

cost to the farmer, but as mentioned above, the States have not yet taken the realistic view that cane prices advised by them, can be met only through free sale realisation from sugar.

In the ultimate analysis therefore there must be a proper nexus between the sugarcane and sugar prices but unfortunately still the theory holds good in Government circles that the domestic prices for sugar under the public distribution system should not be allowed to go up and this continues to dictate the pricing policies for sugar. This is the main reason why the price of sugar is still low as compared with other commodities and this has been made possible only because the industry is being forced by Government to subsidise domestic consumption to a larger extent than before; the existing levels of levy and free sugar prices, even after the more realistic approach by the Government of India towards statutory minimum cane prices, do not give the industry adequate margins over the cost to meet their other normal dividend, depreciation, provision for modernisation, etc. In fact, an expert study has shown that whereas prices in general have shot up by 147% in the last decade, in the case of sugar it is only 79%.

As early as 1959, the Tariff Commission has clearly stated that pricing policy for sugar should guarantee to the factory "in addition to cost of production derived from cost schedules a reasonable return on capital and also to provide funds to the industry to meet its commitments under Bonus, Gratuity, interest on borrowed capital, dividend on preference shares; and leave a residue to a majority of the Units in all regions to declare reasonable dividends.

This recommendation though accepted by Government is still in the realm of wishful thinking and fond hope, so far as the industry is concerned. On the other hand the position has not improved on account of a higher levy price for sugar consequent upon an enhanced minimum cane price during 1984-85 and 1985-86 because of the increased production cost to the industry on account of a high state advised cane price. 70 percent of the cost of the sugar production is taken up with the price of raw material i.e. sugarcane. This situation accounts for the increasing sickness in the industry.

The Indian Sugar Mills Association has made a rough estimate of the losses in the industry over the three years 1981-82, 1982-83 and 1983-84 at Rs.800 crores. A summary study conducted by the Institute Finance Committee for sugar (R. B. I.) has revealed that 67% of the units in the sugar industry are sick. The sickness is not confined to one region or one sector. Even the factories taken over by the Centre or States have fared badly. I would indicate

as the main reason for this state of affairs the lack of cohesion between cane pricing and sugar pricing i.e. between the actual price paid for cane at the behest of State Governments and the total realisations from sugar sales. So, apart from a uniform policy for all sweeteners referred to earlier, this is the most serious problem to which the Centre's attention should be devoted and a formula evolved in consultation with State Governments, as one of the main planks of long term sugar policy.

The working of the sugar industry is conditioned by the quality and quantity of the basic raw material, i.e. sugarcane. The supply varies significantly even from factory to factory and also from season to season, which is not within the control of the factories. This is a great limiting factor when we consider the question of economising on costs. Managerial efficiency as a means of increasing production and profitability has less relevance in the case of the sugar industry because of this factor. The technical efficiency of the sugar industry here has reached a stage comparable with the industry in other parts of the World. But provision of necessary infrastructure by State Governments in the matter of irrigation, feeder roads, etc. can go a long way to augment the economy of the industry. It cannot be said that all the States have created the required infrastructure for the industry and without such proper infrastructure, sugar factories cannot accelerate their development activities.

Added to this, is the cost structure difference under the zoning system with large disparities in cost between factories on account of age or condition of machinery. The Government themselves have only attempted to solve this in a very adhoc manner though fully aware of the vast differences in cost as between factory to factory. They have conceded that only some units have inherently a higher cost structure by classifying them as palpably weak units and have given them an adhoc increase in levy price. More so, because the production of such units does not significantly add to the total output. Thus they have rewarded non-performance at the expenses of normal units instead of finding a proper remedy for a large number of sick units which have come into it. Government has not still accepted in principle that incurably sick factories should be phased out or allowed to merge with healthier units or be made viable by giving incentives as in the case of new factories, grading sickness under the above groups. Their fire-brigade approach to the problem by taking over management of a few sick units, has proved a costly experiment and has only brought out in greater relief, the need for tackling the problem of sickness in the industry by going into the real causes - considering that the sugar industry is even normally an industry

giving the lowest return.

The industrial policy of the Government of India is based on the concept of a mixed economy aimed at the optimum use of installed capacity and also provides for elimination of regional imbalances through development of backward areas together with disbursal of industries keeping in view the country as a whole. But so far as the sugar industry is concerned, there have been some special features. An important structural change has taken over in the managerial pattern of the sugar industry because of the increasing predominance of the Co-operative sector. A significant reason for the growth of this sector is that these factories are owned by the primary producers of cane which is considered to be in the largest interest of cane growers. The Co-operative sector in the industry has come to occupy an important place in the sugar map of India and continues to be encouraged through a system of differential licensing policy and also by State participation in share capital and by loans from Central Financing Institutions. But it is now becoming evident that socio-economic objectives cannot be served merely by permitting a large number of Co-operative factories. Their number in the sick list is alarming enough. I would say that indiscriminate licensing of new factories particularly in the Co-operative sector has resulted in an under utilisation of capacity not visualised in any industrial policy. The Joint Stock Sector, of course, has stagnated because of the large number of Co-operative factories.

The real test to be applied in deciding priorities is whether the additional capacity is being created at the least cost. This is particularly necessary in our country where capital resources are scarce. Expansions are less costly and have shorter gestation period. If an expansion project is able to bring in more production through more cane development efforts and without sizeable expansion in area, it is ideal. The added advantage will be of making existing units viable to the extent possible and bring about reduction in costs through economy of scale. Unfortunately this aspect of the representation of the industry has never been taken seriously enough by the Governments. Expansion of existing projects is still playing only a secondary role in the building up of capacity. Even the VII Plan document seems to lay stress on the creation of new factories as a means of stepping up sugar production. The Government of course have formulated guidelines for starting new factories. But licensing of new factories in the areas of existing units has continued on because of extra economic considerations. The present incentive schemes (Sampath Scheme) should however be modified immediately to guarantee the same incentives to expansion projects which are provided for new factories. This is the

least which Government should do pending further examination of existing ratio between new projects and expansions as recommended in the VII Plan document.

I would also suggest even a Quasi Judicial Body to deal with the grievances of existing factories against installation of new units. It is high time that a stop is put to indiscriminate issue of licences for new factories in the neighbourhood of existing factories inspite of the guidelines of the Government of India. The industry has repeatedly represented that, even regarding VII Plan projections, the existing capacity has been underassessed and as a result a large number of new sugar factories have been estimated as necessary to cope up with the increasing demand for sugar.

While one cannot quarrel with the decision of the Government to support Co-operative sector in the sugar industry and give preferences to the Co-operative sector in the opening of new units, it cannot be said that the Co-operative sector alone can deliver the goods in the sugar industry. The number of sick units in the Co-operative sector is appreciable. Maharashtra State is a classic example of the joint stock factories being slowly and surely edged out of existence - not because of any inherent defects noticed but because of the setting up of new factories close to them and taking away their developed cane areas to provide a nucleus to the new units which are allowed to come into existence on non-economic considerations and in clear violation of the guidelines of Government of India for setting up new factories.

It is a known fact that the Co-operative factories divert their entire profits to cane growers by way of additional cane price. Incidentally they thus avoid paying tax to the exchequer. The cane grower in the Co-operative factory has hardly any interest in the factory to which he is tied as a share holder because he gets a higher cane price and need not worry about a dividend. In fact the cane growers get the upper hand; Co-operative factories are helpless when cane growers divert to manufacture jaggery especially during the season of short supply. Looking from the larger national point of view, we may see that while the tax-payer foots the initial capital expenditure, the entire profits of the Co-operative sector are diverted only for the benefit of one section of the community i.e. the cane farmer. The Exchequer also loses income-tax. The financial viability of the Co-operative sector of the industry is the same as the joint stock sector.

Much has been talked about the need for cane development by the factories. The main problem seems to be in areas where there is not direct contact between the sugar factories and sugarcane growers

as for example in the Northern India viz. U. P. and Bihar. In the absence of such contact, factories have taken little interest in cane development work. The only remedy in these areas is to permit the sugar factories to procure sugarcane directly from the sugarcane growers as in the South.

On the recommendations of a high level committee of the Government of India, a sugar development fund has been created by the Government of India to grant loan assistance to sugar factories for rehabilitation and modernisation, including cane development. An earlier scheme was the "Soft Loan Scheme" of the Industrial Development Bank of India. This scheme did not even touch the fringe of the problem. It is unfortunate that even the present Sugar Development Fund which has now accumulated to about Rs.300 crores has not been properly utilised. The official version is that sufficient applications are not received. But in practice it is found that it is very difficult to satisfy the requirements for loan eligibility to obtain this loan of credit. This scheme has to be liberalised to make it really effective so as to provide a resource to sugar mills both for modernisation and development of sugarcane.

On the one hand, Government seems to be aware that with the present pattern of state advised cane prices and levy sugar prices, the sugar industry is not able to generate sufficient internal resources to make prompt cane payments and also renew their machinery - but these half hearted measures have never come to the rescue of the industry in solving their liquidity problems. The fluctuating operations of the industry caused by other factors mentioned above, viz. lack of uniform policy for sweetening agents and defective licensing policy has not given any scope to the industry to plough back its profits but has helped only towards occasionally building up inventories in a favourable year and nothing else. The industry is kept on tender hooks even to keep its head above water i.e. finding funds for its daily operations and for repairs and maintenance because of its low profitability. The only area which admits of some pioneering effort is the utilisation of by-products, which factories are being forced to think of, even for survival. This however calls for a co-ordinated approach on a national scale along with provision of necessary incentives.

Government's policy towards all sweetening agents, towards cane pricing and fixing levy prices provides the key to all the problems of the industry. A more pragmatic licensing policy which will provide for additional capacity at minimum cost is another measure to be undertaken in national interest i.e. with an accent on encouraging expansions. Sugar cane is an important agricultural good used as raw

material. It has to be declared so by the Centre and the largely varying levies by States on sugar cane be put a stop to. Buffer stocks have to be created permanently and India should be a regular exporter.

However, I feel personally that the problems of the industry are receiving more sympathetic attention in recent years and this raises some hope.

ANNEXURE I

PROFITABILITY AND OTHER RATIOS OF SUGAR INDUSTRY

	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83
Tax as Percentage of Profit Before Tax	39.1	48.0	53.2	56.0	131.5	53.2	109.9	276.0	74.1	33.7	36.9	60.4
Dividend as Percentage of Profit Before Tax	27.0	16.8	21.8	14.1	43.6	17.7	40.2	1360.0	23.2	15.9	25.2	43.6
Retained Profits as Percentage of Profit Before Tax	33.3	35.2	25.0	19.9	-75.0	29.1	-50.1	-411.0	2.7	75.9	60.1*	+
Gross Profits as Percentage of Net Sales	9.4 (10.4)	12.2 (9.5)	9.5 (10.5)	8.8 (11.4)	5.4 (9.2)	8.0 (9.0)	6.9 (9.0)	6.4 (10.5)	7.5 (11.0)	9.2 (9.8)	8.8 (9.3)	8.6 (8.7)
Gross Profits as Percentage of Total Capital Employed	8.9 (10.4)	15.5 (10.3)	9.7 (11.0)	9.6 (12.8)	6.1 (10.6)	10.6 (11.0)	7.0 (11.0)	5.5 (12.0)	7.9 (12.6)	13.0 (12.0)	10.5 (11.2)	7.7 (9.7)
Profit After Tax as Percentage of Net Worth	9.5 (10.5)	16.9 (10.3)	11.3 (11.9)	9.6 (13.7)	+	9.0 (7.9)	+	+	3.4 (14.0)	18.5 (14.2)	10.9 (13.4)	4.6 (11.0)
Dividend as Percentage of Net Worth	4.4 (5.4)	5.7 (5.5)	5.0 (4.6)	3.1 (4.1)	2.5 (4.7)	3.4 (5.1)	2.7 (5.2)	2.7 (5.6)	3.0 (5.6)	4.5 (5.4)	4.3 (5.2)	5.0 (4.7)

The Saswad Mali Sugar Factory Ltd.

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Malinagar

Board of Directors

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Secretary to the Board of Directors

THE ROLE OF THE CO-OPERATIVE SECTOR IN INDIAN SUGAR INDUSTRY

Dr. G. J. Khudanpur & Prof. M. V. Salvekar

"The co-operative form of organisation partakes of all the characteristics of a many faceted activity; philosophical idea, an ethical doctrine, a social discipline, an economic instrument, an organisational device and a managerial technique - all these at one and the same time."

Dr. B. Venkatappiah

1. General

1.1 The above quotation taken from the key Note address of Dr. B. Venkatappiah delivered at the First National Convention of The Indian Society for Studies in Co-operation, Pune, on 7th June, 1980 aptly describes the role played by the co-operative sector of the Indian Sugar Industry. In the present article the Authors have examined the role of the co-operative sector in the Indian Sugar Industry by focussing attention on the many facets of the cooperative form of organisation and endeavor.

2. Introduction

2.1 India is the country of origin of sugarcane. Reference to sugarcane as "Sweet grass" may be found in ancient vedic literature dating back to the year 3000 BC. Accounts of early travellers indicate that sugarcane was carried into China and other places from North East India by travellers and nomads between 1800 and 1700 BC. Later it spread to Philippines, Java and other places including caribbean islands through the explorers.

2.2 India - the mother country of Sugarcane, occupies a place of pride in the world even to day. India is foremost among the sugarcane producing countries in the world. It produces annually about 180 million tonnes of cane. This is utilised to produce sweetening agents such as crystal sugar, gur and khandsari. However, world sugar statistics take cognisance of production of crystal sugar only. From a production of less than 0.1 million tonnes of crystal sugar per year in early 1930's, India attained a production of 8.4 million tonnes in 1981-82 to emerge as the leading world producer

of white crystal sugar.

2.3 The commendable progress and achievements of the sugar industry in India owe much to the careful planning and development by the Central and State Governments. In fact, state protection has played a major role in establishing and developing this Industry.

3. Policy of Protection

3.1 In 1930 AD, Government of India appointed an ad-hoc tariff board to investigate and report on the Sugar Industry in India with special reference to the question of giving tariff protection to the industry. In its report submitted in 1931 the Board recommended that the Indian Sugar Industry be protected as it satisfied all the conditions necessary for the grant of protection, viz. :

- (a) Abundant supply of raw material
- (b) Cheap power through use of bagasse as fuel.
- (c) Abundant supply of cheap local labour.
- (d) Large domestic market.
- (e) Necessity of protection - as without protection the industry would not develop at all.

It further recommended grant of protection to the industry initially for 15 years and imposition of a protective tariff of Rs.7.25 per cwt on imported sugar for the first 7 years and a protective tariff of Rs.6.50 per cwt for the subsequent 8 years. However in fact, protection was granted for 14 years only and the protective duty was fixed at Rs.7.25 per cwt plus a surcharge of 25%. As a result of this protection the domestic sugar industry expanded rapidly and within four years from the date of extension of tariff the country became practically self sufficient in sugar. This, however, resulted in a serious loss of customs revenue to the Government, the customs revenue declining from Rs.10.8 crores in 1930-31 to Rs.3.24 crores in 1935-36. To compensate

* Prof. Salvekar is currently, Dean of the Faculty of Mental Moral, and Social Sciences, University of Poona.

Table 2

Country-wise Export of Sugar from India

(Quantities in Metric Tonnes)

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Afghanistan	-	10000	10500	-	10000	-	-	-	-	-
Algeria	-	-	1000	-	-	-	-	-	-	-
Aden/Mukalla	22453	12100	-	-	-	-	-	-	-	-
Bangla Desh	-	-	-	-	-	16450	10000	-	-	-
Somalia	-	-	21000	-	-	21350	-	-	-	-
China	-	-	-	-	71150	20500	-	-	85900	11000
Djibouti	-	-	-	-	1300	-	-	-	-	-
Egypt	11500	169698	77200	19782	43500	80900	11550	-	26950	280046.2
Hungary	-	11550	-	-	-	-	-	-	-	-
Indonesia	33500	44549	154475	98470	253297	191303	-	84000	278742	27000
Iran	130531	383874	124567	-	-	-	-	-	-	-
Iraq	-	-	9000	-	-	-	-	-	-	-
Jordan	23100	9082	11000	-	-	-	-	-	-	-
Kenya	-	-	-	4850	-	41250	-	-	-	-
Maldives	1400	400	350	1050	2400	5175	-	-	1000	1900
Morocco	22500	-	-	-	-	-	-	-	-	63800
Nepal	-	2671	4329	-	-	-	1500	-	-	-
N. Korea	-	-	-	-	30800	-	5230	-	-	-
Oman	-	-	-	250	-	-	-	-	-	-
Portugal	-	-	12100	-	-	-	-	-	-	-
Qatar	-	1500	-	-	-	-	-	-	-	-
Romania	-	-	63100	-	-	-	-	-	-	-
Sri Lanka	20808	9910	12600	27530	85150	222050	-	14000	40808	172400.1
Sudan	65840	77758	105303	19550	70000	12000	11500	-	13200	35600
Sechelleys	-	-	-	800	-	-	-	-	-	-
Tunisia	-	11400	6100	-	-	-	-	-	-	35100
Tanzania	-	-	11000	19400	-	-	-	-	-	-
U. K.	25400	35100	27600	27120	23800	25476	24441	-	-	-
U. S. A.	74732	164425	140613	-	-	-	-	-	19625	20100
U. A. R.	-	-	-	-	10300	-	-	-	-	-
Yemen	11550	22050	51565	36000	34000	-	-	-	-	-
Pakistan	-	-	-	-	-	19600	-	-	-	-
Lebanon	-	-	-	-	-	-	-	-	303*	-
Y. A. R.	-	-	-	-	-	-	-	-	-	67200
Ecuador	-	-	-	-	-	-	-	-	-	10237.7
Total	443364	966067	843402	254802	635697	656054	64291	98000	466525	724384

* Gift to Lebanon

for the loss of customs revenue and to neutralise the extra protection enjoyed by the sugar industry as a result of the levy of a 25% surcharge, an excise duty of Rs.1.31 per cwt was imposed on factory produced

sugar. Over the years the rate of excise duty on sugar has been progressively increased and consequently it has become an important source of revenue to the Government (see Table 1) yielding a revenue in excess of Rs.316 crores in 1982-83.

3.2 Another consequence of tariff protection was that India ceased to be an importer of sugar and became a net exporter of sugar. The sugar exports have steadily gone up from 1.47 lakh tonnes in 1957 to 7.24 lakh tonnes in 1983. In fact, under the International Sugar Agreements, India had been awarded an export quota of 8 lakh tonnes. In Table 2 data has been furnished about countrywise export of sugar from India.

4. Era of Planning

4.1 With the dawn of the era of planning in India, the sugar industry came to receive increasing attention. Specific targets for installed capacity and production were established and vigorous attempts were made to encourage the industry to expand. The industry responded in magnificent way. In the very first plan the target of production was exceeded and hence the target was revised upwards from 15 lakh tonnes to 18 lakh tonnes. In fact the sugar industry has consistently exceeded the target set for production in every five year plan, (see Table 3), save the fourth, when the target could not be achieved due to the prevalence of severe and prolonged drought conditions over a large part of the cane growing area.

4.2 The Government regards the co-operative form of organisation as an instrument of planning and development. Consequently highest priority was given to the cooperative sector in the matter of licensing. The cooperative sector has also responded well to the Government's policy of encouragement. The result was a rapid expansion of the sugar industry. The data regarding the progress of the industry has been presented in Table 4.

4.3 It may be observed from the data in Table 4 that in the three decades encompassing the first five five-year plans the number of sugar factories in the country increased from 139 to 300. During the same period the total quantity of cane crushed increased from 11.3 million tonnes to reach a level of 67.3 million tonnes. The quantity of sugar produced increased from 1.1 million tonnes in 1950-51 to 6.4 million tonnes in 1977-78. By the year 1981-82 it had reached the level of 8.4 million tonnes and India emerged as world leader in sugar production.

4.4 In 1950-51 prior to the initiation of the era of planning there were 139 sugar factories in the country with an installed capacity of 16.7 lakh tonnes and actual production of 11.3 lakh tonnes. Of these 139

Table 1
Excise Duty Collections from
Vacuum Pan Sugar and Khandsari

(in lakh Rs.)

	Vacuum Pan Sugar	Khandsari	Total
1952-53	1,017	--	1,017
1953-54	1,341	--	1,341
1954-55	806	--	807
1955-56	1,844	--	1,844
1956-57	2,075	--	2,025
1957-58	4,251	--	3,225
1958-59	6,026	--	6,026
1959-60	5,976	31	6,007
1960-61	5,482	50	5,432
1961-62	5,842	37	5,879
1962-63	7,498	33	7,531
1963-64	6,617	47	6,664
1964-65	6,618	62	6,580
1965-66	7,500	88	7,588
1966-67	11,012	79	11,091
1967-68	7,396	48	7,480
1968-69	6,655	153	6,808
1969-70	10,215	196	10,215
1970-71	13,801	179	13,980
1971-72	16,320	147	16,467
1972-73	17,540	186	17,726
1973-74	19,547	245	19,792
1974-75	19,050	537	19,587
1975-76	22,485	1685	24,170
1976-77	22,746	1174	24,120
1977-78	20,174	1237	21,411
1978-79			18,869 @
1979-80			28,031 @
1980-81			24,830 @
1981-82*			29,494 @
1982-83*			31,674 @

* Provisional

@ Breakup for vacuum pan sugar khandsari is not available.

Table 4

Statement showing Number of Factories In Operation,
Cane Crushed, Sugar Produced & Recovery

Plan Period	Year	No. of factories in operation	Total cane crushed (' 000 tonnes)	Total sugar produced (' 000 tonnes)	Recovery of sugar cane %
1st Plan 1951-52	1950-51	139	11348	1100	9.99
	1951-52	140	15886	1474	9.57
	1952-53	134	13219	1277	9.98
	1953-54	134	9778	985	10.08
	1954-55	136	15759	1566	9.93
	1955-56	143	18642	1834	9.93
2nd Plan	1956-57	147	20536	1998	9.73
	1957-58	158	19438	1946	10.01
	1958-59	164	19187	1889	9.84
	1959-60	168	24011	2384	9.92
	1960-61	174	31021	3021	9.74
3rd Plan 1961-62	1961-62	180	27946	2729	9.76
	1962-63	186	20799	2139	10.28
	1963-64	194	25716	2573	10.01
	1964-65	128	33454	3232	9.66
	1865-66	200	36512	3541	9.70
4th Plan / Plan Holiday	1966-67	200	21637	2151	9.94
	1967-68	200	22638	2248	9.92
	1968-69	205	37699	3559	9.47
4th Plan 1969-70	1969-70	215	45701	4262	9.33
	1970-71	215	38205	3740	9.79
	1971-72	220	31015	3113	10.04
	1972-73	228	40407	3873	9.57
	1973-74	229	42278	3948	9.34
5th Plan	1974-75	246	48435	4797	9.90
	1975-76	252	41880	4262	9.83
	1976-77	270	48819	4840	9.91
	1977-78	287	67329	6461	9.59
	1978-79@	298	59717	5841	9.78
	1979-80*	300	33000 *	3900 *	10.00*

* Provisional

@ 5th Plan was terminated in 1977-78, i.e. one year earlier.

Table 3
Targets and Actual Production
During the Plan Period

Five Year Plan	Sugar Production (in lakh tonnes)	
	Target	Actual
1951 - 52 to 1955 - 56	15 (18)	18.90
1956 - 57 to 1960 - 61	25	30.27
1961 - 62 to 1965 - 66	35	35.36
1969 - 70 to 1973 - 74	47	39.48
1974 - 75 to 1979 - 80	60	64.60
1980 - 81 to 1984 - 85	76	84.37

tive units one was in Maharashtra and two were in Andhra Pradesh. By 1980 the situation had changed materially and the number of sugar factories had risen to 300.

4.5 On 30.9.1983 there were 380 licensed sugar factories in the country. Their break-up sector-wise and state-wise has been presented in Table 5. From the sectoral distribution of factories it may be seen that the co-operative sector has exhibited a phenomenal growth, the number of co-operative sugar units having increased from 3 to 200. The public sector also is making its presence felt. As regards the private sector it may be noted that it has not only not grown but has actually contracted from 136 to 131 units. This is the result of deliberate official policy to favour the cooperative sector.

4.6 As regards regional distribution of sugar factories,

Table 5
Share of Cooperatives as on 30.9.1983

State	Total number of Licensed Sugar Factories				Total number of Installed Sugar Factories			
	Private	Public/ State owned	Coop.	Total	Private	Public/ State owned	Coop.	Total
Uttar Pradesh	56	19	29	104	55	18	19	92
Bihar	21	9	--	30	21	9	--	30
Punjab	2	3	8	13	2	2	4	8
Haryana	1	--	7	8	1	--	4	5
West Bengal	1	1	--	2	1	1	--	2
Assam	--	1	2	3	--	1	1	2
Nagaland	--	1	--	1	--	1	--	1
Rajasthan	1	1	1	3	1	1	1	3
Madhya Pradesh	5	1	3	9	5	--	2	7
Orissa	1	2	2	5	1	--	2	3
Maharashtra	11	--	81	92	11	--	68	79
Gujarat	--	--	16	16	--	--	15	15
Goa	--	--	1	1	--	--	1	1
Tamil Nadu	12	2	11	25	10	2	10	22
Karnataka	8	3	17	28	8	2	13	23
Pondicherry	1	--	1	2	1	--	--	1
Andhra Pradesh	10	5	18	33	10	5	15	30
Kerala	1	--	2	3	1	--	2	3
Manipur	--	1	--	1	--	--	--	--
Dadra & Nagar Haveli	--	--	1	1	--	--	--	--
All India	131	49	200	380	128	42	157	327

the sub-tropical belt of North India had 109 sugar factories accounting for 78% of the production of sugar in 1950-51 while the tropical belt of South India had 30 factories accounting for the balance 22% of sugar production. The situation has changed drastically over the years. In fact, in 1983 the subtropical belt had 174 factories as against 106 in the tropical belt. This shows that the growth rate is very high in the tropical belt not only because of the favourable agro-climatic factors but also because of the strong upsurge of the cooperative sugar movement in the tropical belt - especially in Maharashtra, Andhra Pradesh,

Karnataka and Tamil Nadu. As regards production of sugar the tropical belt has moved ahead of the sub-tropical belt. In fact, of the total licensed production of sugar the tropical belt has moved ahead of the sub-tropical belt. In fact, of the total licensed production capacity of 79.57 lakh tonnes the sub-tropical belt accounted for 20.48 lakh tonnes (37.6%) while the tropical belt accounted for 50.09 lakh tonnes (62.4%). The data on licensed annual sugar production capacity sector-wise and state-wise has been presented in Table 6. The data clearly demonstrates the marked shift of the industry from the sub-tropical belt of

Table 6
Licensed Annual Sugar Production Capacity as on 30.9.1983
(In lakh tonnes)

State	Private	Public/ State owned	Cooperative	Total
Uttar Pradesh	12.242	3.244	4.71	20.196
Bihar	2.96	0.85	--	3.81
Punjab	0.26	0.33	0.922	1.512
Haryana	0.82	--	1.02	1.84
West Bengal	0.10	0.10	--	0.20
Assam	--	0.12	0.24	0.36
Nagaland	--	0.12	--	0.12
Rajasthan	0.10	0.07	0.09	0.26
Madhya Pradesh	0.42	0.09	0.27	0.78
Orissa	0.03	0.18	0.19	0.40
Maharashtra	2.49	--	21.196	23.686
Gujarat	--	--	5.155	5.155
Goa	--	--	0.20	0.20
Tamil Nadu	3.34	0.37	2.64	6.35
Karnataka	2.53	1.405	3.885	7.82
Pondicherry	0.19	--	0.15	0.34
Andhra Pradesh	2.64	0.99	2.38	6.01
Kerala	0.04	--	0.18	0.22
Manipur	--	0.12	--	0.12
Dadra & Nagar Haveli	--	--	0.195	0.195
All India	28.162	7.989	43.423	79.574

Note :

In addition to this, capacity registered under liberalised licensing policy is 2.082 lakh tonnes. Total licensed capacity : 79.574 + 2.082 = 81.656 lakh tonnes.

Table 7
Installed Annual Sugar Production Capacity as on 30.9.1983
(In lakh tonnes)

State	Private	Public/ State owned	Cooperative	Total
Uttar Pradesh	10.764	2.57	2.93	10.264
Bihar	2.625	0.85	--	3.475
Punjab	0.18	0.22	0.48	0.88
Haryana	0.53	--	0.63	1.16
West Bengal	0.10	0.05	--	0.15
Assam	--	0.12	0.08	0.20
Rajasthan	0.06	0.07	0.09	0.22
Madhya Pradesh	0.34	--	0.18	0.52
Orissa	0.03	--	0.19	0.22
Maharashtra	2.44	--	18.32	20.76
Gujarat	--	--	4.41	4.41
Tamil Nadu	2.92	0.37	2.455	5.745
Karnataka	2.11	1.05	2.67	5.83
Pondicherry	0.19	--	--	0.19
Andhra Pradesh	2.27	0.99	1.83	5.09
Kerala	0.04	--	0.18	0.22
Nagaland	--	0.12	--	0.12
Goa	--	--	0.20	0.20
Dadra & Nagar Haveli	--	--	--	--
All India	24.599	6.41	34.645	65.654

Note :

In addition to this, capacity implemented under liberalised licensing policy is 0.246 lakh tonnes.
Total Installed Capacity : 65.654 + 0.246 = 65.90 lakh tonnes.

North India to the tropical belt of South India due primarily to the rapid growth of the cooperative sector of the sugar industry in the agro-climatically favourable tropical belt of South India.

4.7 After the license is issued it takes two to three years to convert it into installed capacity, the gestation period for a Sugar Unit being 2/3 years. In Table 7 data on installed capacity has been presented sector-wise and state-wise. It may be noted that there is no marked difference in the rate of conversion of licensed capacity into installed capacity sector-wise though region-wise the tropical belt appears to be more efficient in converting capacity into Installed capacity.

4.8 We have seen from data presented in Table 5 that in 1983 out of 380 factories licensed 200 were cooperatives. In Table 8 we present data about these 200 licensed units to show their progress towards installation of capacity. It may be noted that out

of 200 units licensed by the Government 157 have already been established. Of these 156 are actually in operation.

4.9 In Table 9 we have presented yearwise data regarding the growth of the cooperative sector and its share of the Indian sugar production. It may be noted from the data that the share of the cooperative sector in Indian sugar production has gone up from 17.4% in 1961-62 to 54.7% in 1982-83. That is in just over two decades the cooperative sector has more than tripled its share in sugar production and has emerged as the major sector of the industry. It may also be noted while passing that the number of cooperative sugar factories in operation has increased from 34 in 1961-62 to 156 in 1982-83. On the other hand the production has jumped up from 4.75 lakh tonnes to a remarkable 45.10 lakh tonnes over the same period.

Table 8
Cooperative Sugar Factories on 30th September, 1983

State	Licensed/ already converted to Coopera- tives	already esta- blished	To be esta- blished	Orders for Plant & Machinery placed	Yet to place orders for plant and Machinery
Uttar Pradesh	29	19	10	7	3
Bihar	--	--	--	--	--
Punjab	8	4	4	2	2
Haryana	7	4	3	3	--
Assam	2 @	1	1	1	--
Rajasthan	1	1	--	--	--
Madhya Pradesh	3	2	1	1	--
Orissa	2	2	--	--	--
Maharashtra	81	68	13	12	1
Gujarat	16	15	1	1	--
Goa	1	1	--	--	--
Tamil Nadu	11	10	1	--	1
Karnataka	17	13	4	3	1
Andhra Pradesh	18	15	3	3	--
Pondicherry	1	--	1	1	--
Kerala	2	2	--	--	--
Dadra & Nagar Haveli	1	--	1	--	1
All India	200	157	43	34	9

@ Including Nowgong in Assam converted from Public Sector to Cooperative.

* Includes Ulunderpet in Tamil Nadu converted from Public Sector to Cooperative

This is indicative of the vigour of the growth of the cooperative sector, which is steadily growing to dominate the Indian Sugar scene.

5. Growth of the Cooperative Sector

5.1 In the wake of attainment of independence, India embarked on a programme of planned development, with the object of building up rapidly an expanding economy and a social order based on justice and equity for all through the process of democracy. The first five-year plan recognised cooperation as an effective instrument of democratic planning combining initiative, mutual benefit and social purpose. The subsequent plans recognised that :

"In a planned economy pledged to the values of socialism and democracy, cooperation should become progressively the principal basis of organisation in many branches of economic life".

5.2 Cooperation has a vital role to play in our economy, which has its roots in the village. It has the merit of combining freedom of organisation for the small man with the benefits of large scale management. It gives to the social structure and the national economy balance, direction and a new sense of values. It is the principal means for bringing about changes of a fundamental nature within the economy - particularly the rural economy, where cooperation is something much more than a series of activities organised on cooperative lines. Basically, the purpose of cooperation is to evolve a scheme of cooperative community organisations which touches upon all aspects of rural life.

5.3 Within the rural economy, cooperation is of signal importance as a means of raising the level of productivity, extending improvements in technology, and creating greater and greater employment opportu-

Table 9

Year	No. of Sugar Factories in Operation		Sugar Production (lakh tonnes)		% of Cooperative to Total
	Cooperative	Total	Cooperative	Total	
1961-62	34	180	4.75	27.29	17.4
1962-63	41	186	4.73	21.39	22.1
1963-64	48	194	6.01	25.73	23.4
1964-65	50	198	7.95	32.32	24.6
1965-66	53	200	9.41	35.41	26.6
1966-67	55	200	6.62	21.51	30.8
1967-68	58	200	7.05	22.48	31.4
1968-69	63	205	12.06	35.59	33.9
1969-70	70	215	13.82	42.62	32.4
1970-71	73	215	12.62	37.40	33.8
1971-72	79	220	12.85	31.13	41.3
1972-73	85	228	14.67	38.73	37.9
1973-74	84	229	15.54	39.48	39.4
1974-75	96	246	20.93	47.97	43.7
1975-76	103	252	20.33	42.62	47.7
1976-77	116	270	23.13	48.40	47.8
1977-78	129	287	31.75	64.61	49.1
1978-79	136	298	30.52	58.41	52.3
1979-80	138	300	20.32	38.58	52.7
1980-81	149	315	29.03	51.48	56.4
1981-82	153	320	46.04	84.37	54.6
1982-83	156	320	45.10	82.40	54.7

nities. Once the process of social and economic progress gathers momentum the cooperative movement has an increasingly important role to play, by creating a network of cooperative organisations and institutions to cater to the existing needs of the community and to capitalise on the developing opportunities.

5.4 The cooperative movement has played a major role in developing the sugar industry in India. It has also played a very important role in improving the income, the standard of living and quality of life of the sugarcane growers in the factory zones. It has also played a catalytic role in bringing about rapid industrialisation of rural areas, in modernising agriculture and in transforming rural society. It has also played a vital role in developing infrastructural facilities

and social overheads. In the following we shall elaborate on these various facets of the activities of the cooperative sugar units.

5.5 In Table 10 we have presented a statistical picture of the growth of the cooperative sugar industry between 1960-61 and 1982-83. The number of cooperative sugar factories in operation had increased from 30 in 1960-61 to 173 in the year 1982-83. Over the same period the membership of cooperative sugar factory increased from 1.63 lakhs to 14.67 lakhs. Bulk of them were grower members who constituted approximately 92% of the total membership. In average number of members per factory has increased from 5433 in 1960-61 to 8470 in 1982-83 indicating that the factories are having a sound base ensuring adequate supplies

Table 10
Growth of Membership of Cooperative Sugar Factories
(1960-61 to 1982-83)

Year	No. of factories reporting	Growers members (' 000)	Others (' 000)	Total (' 000)	% of grower members to total members
1960-61	30	151	12	163	92.6
1961-62	34	168	19	187	89.8
1962-63	41	185	20	205	90.2
1963-64	48	213	21	234	91.0
1964-65	57	227	21	248	91.5
1965-66	68	258	22	280	92.1
1966-67	76	288	24	312	92.3
1967-68	76	316	25	341	92.7
1968-69	76	341	25	366	93.2
1969-70	104	423	30	453	93.4
1970-71	109	475	36	511	93.0
1971-72	121	518	39	557	93.0
1972-73	126	562	41	603	93.2
1973-74	125	647	42	689	93.9
1974-75	138	733	40	773	94.8
1975-76	137	788	47	835	94.4
1976-77	145	914	53	967	94.5
1977-78	170	1035	69	1104	93.8
1978-79	163	1106	79	1185	93.3
1979-80	167	1159	67	1226	94.5
1980-81	168	1227	89	1316	93.2
1981-82	172	1316	90	1406	93.6
1982-83	173	1355	112	1467	92.4

of cane from members.

5.6 In Table 11 we have presented data on the progressive share capital position on 31st March, for the years 1960-61 to 1982-83 in respect of the cooperative sugar factories. This has been done primarily to indicate the massive effort made by cooperative sugar units to mobilise financial resources and the success achieved by them in this respect. In fact, between 1960-61 and 1982-83 the cooperatives were able to increase their share capital from Rs.16.4 crores to Rs.316.5 crores. The bulk of this viz. Rs.190.9 crores represents the contribution of the state governments towards the capital of these cooperative units. It may be noted that from 1976-77 onwards the contribution of the state governments is substantially more than that of the members of the Society. This was primarily due to two factors viz. (i) steep jump in the project

costs requiring additional government contribution to maintain the prescribed debt equity ratio and (ii) extension of the cooperative movement to backward areas of the state, where the membership was economically too weak to make full contribution to the share capital.

Apart from share capital the cooperatives had many other sources of owned funds such as reserve fund, depreciation fund, development fund, statutory deposits and non-refundable deposits from members. The total owned funds would therefore be substantially larger than the share capital of the cooperatives. Such data was not available for all cooperative sugar factories. However, to bring out the fact that the total owned funds are many times more than the share capital mobilised by the cooperatives such data has been presented about the cooperative sugar factories in

Table 11

The Progressive Share Capital Position as on March 31, for the years 1960-61 to 1982-83

Year	No. of reporting factories	Special Capital Contributed By		Others	Total	% of Growers Share to Total
		Growers	State Govts.			
1960-61	30	7.8	6.5	2.1	16.4	47.5
1961-62	34	9.1	8.2	2.1	19.4	46.9
1962-63	41	10.3	8.8	2.1	21.2	48.6
1963-64	48	11.9	9.1	2.3	23.3	51.1
1964-65	57	12.8	9.4	2.3	24.5	52.2
1965-66	68	15.5	10.5	2.3	28.4	54.8
1966-67	76	16.8	12.6	2.5	31.9	52.5
1967-68	76	20.1	14.5	2.5	37.1	54.2
1968-69	76	22.6	15.2	2.5	40.4	56.1
1969-70	104	23.4	18.3	3.6	45.3	58.9
1970-71	109	33.6	21.9	3.6	49.4	56.6
1971-72	121	38.2	25.9	3.9	67.7	56.4
1972-73	126	44.3	31.6	4.4	80.3	56.2
1973-74	125	49.9	35.2	3.7	88.8	56.2
1974-75	138	56.6	47.3	3.7	107.6	52.6
1975-76	137	60.9	58.1	9.8	128.8	47.3
1976-77	145	60.9	82.8	5.3	158.8	44.4
1977-78	170	83.8	121.9	6.8	212.1	39.4
1978-79	163	87.4	116.0	10.7	214.1	40.8
1979-80	167	94.8	141.7	6.6	243.1	39.0
1980-81	168	99.4	158.1	11.5	262.0	37.0
1981-82	172	104.5	164.5	9.2	278.2	37.4
1982-83	173	113.6	190.9	12.0	316.5	35.9

Maharashtra for the years 1960-61 to 1969-70 in Table 12.

5.7 To encourage the organisation of cooperative sugar factories the Central Government is giving highest priority to the cooperative sector in the matter of licensing. It has also evolved a pattern of finance to ensure that the sugar cooperatives are not starved for project finance. The finance for the project is provided on a debt-equity ratio of 60:40. Thus, when the project cost used to be Rs.350 lakhs the Industrial Finance Corporation of India (IFCI) provided a loan of Rs.210 lakhs, the state government contributed Rs.95 lakhs and the members were required to contribute Rs.45 lakhs towards the share capital in Maharashtra. Further, the Reserve Bank of India through the Cooperative credit structure made available to prospective members of the cooperative sugar factories loan upto 75% of the value of the share to be purchased. Since the share was of the face value of Rs.1,000/-, loan upto Rs.750/- per member was made available to the prospective members. To encourage opening up of backward areas the state governments contributed a significantly larger sum towards the share capital of cooperative sugar units organised in backward districts. Further as the project cost jumped up steeply

after 1976-77, the state government had to make a larger contribution to the share capital of the sugar cooperatives as the members of the units to be newly organised were unable to raise the necessary equity capital on their own. Hence there has been a substantial increase in the contribution of the state governments to the share capital of cooperative sugar units as noted by us earlier in paragraph 5.6.

5.8 Cooperatives can be organised by producers, workers or consumers. Sugar Cooperatives are organisations of producers i.e. the cane growers, and as such they operate for the actual benefit of their members as producers and owners for the purpose of converting their sugarcane into sugar and other products, selling these products and returning to their member - patrons, under a contractual obligation, all revenues that remain over and above the cost of performing the services. Under a document called "Membership and Marketing Agreement" the cane grower-member is generally required to deliver all of the sugarcane he produces to the sugar factory. The sugar factory on the other hand is obliged to receive the member's cane, process it, and sell the products and return to the grower members on a pro-rata basis, all proceeds remaining after payment

Table 12
Statement Showing the Member Cooperative Sugar Factories, Own Funds
from the Years 1961-62 to 1969-70

Year	Share Capital	Reserve Fund	Depreciation Fund	Development Fund	Other Funds	Total	Statutory Deposit	Total
1960-61	366.13	25.28	319.96	87.87	23.14	822.38	150.39	1254.05
1961-62	499.23	31.21	406.96	92.09	50.90	1080.39	297.64	1024.46
1962-63	769.05	46.91	651.03	98.67	68.70	865.31	337.91	1972.27
1963-64	836.52	55.08	689.53	180.38	48.21	973.25	436.17	2245.94
1964-65	868.99 *190.00	67.81	751.10	211.16	59.37	1089.58	530.50	2488.99
1965-66	930.94 *200.00	77.99	928.49	262.27	57.40	1266.39	653.27	2848.56
1966-67	988.89 *221.75	88.17	985.76	213.38	55.89	1443.20	776.04	3208.13
1967-68	1144.95 *213.75	95.07	1142.33	355.59	70.72	1663.31	991.09	3799.75
1968-69	1381.18 *262.75	107.83	1352.40	513.34	76.51	2050.08	1158.37	4589.63
1969-70	1878.62 *371.07	116.71	1609.69	84.49	115.93	2426.82	1383.86	5689.30

* Government Share

Table 14

All India figures about
Sugar Production

Year	Area under cultivation (ha)x1000	Cane yield (t/ha)	Sugarcane production (tx1000)	No. of factories in operation	Cane crushed (tx1000)	Recovery %	Total sugar produced x 1000t	Sugar production per ha.
1932-33	1386	37.5	51950	56	3404	8.66	295	3.22
1945-46	1299	36.4	47273	145	9510	10.09	959	3.67
1960-61	2413	45.7	110544	174	31109	9.74	3028	4.43
1975-76	2762	50.9	140604	253	41849	10.19	4261	5.18
1976-77	2872	53.6	154023	271	48967	9.92	4840	5.32

Source : Indian Sugar,
Vol. 27 (9), 1977

Table 15

Productivity of Sugarcane Per Hectare in Different States : 1965-78
(T/Ha)

State	1965-66	67	68	69	70	71	72	73	74	75	76	77	78
Uttar Pradesh	38.0	33.1	38.0	42.0	44.1	40.6	3.8	43.4	41.3	41.2	40.5	45.7	47.8
Haryana	38.8	33.8	38.9	41.8	46.9	45.0	5.1	44.1	39.7	36.6	43.5	43.3	45.5
Bihar	35.6	29.5	34.3	39.0	39.1	38.4	1.5	35.4	37.2	39.6	36.7	32.7	35.7
Punjab	24.6	27.9	35.8	33.0	41.6	41.3	3.1	45.8	52.8	50.0	53.7	52.3	56.2
Madhya Pradesh	23.7	23.1	25.5	25.6	25.1	26.6	7.7	26.4	26.7	24.8	31.9	30.2	29.9
Rajasthan	16.5	12.2	15.7	13.8	13.3	32.7	3.6	39.8	48.4	42.3	38.8	45.1	46.3
Assam	33.1	33.2	37.9	35.3	47.8	37.3	7.7	38.2	40.4	38.4	37.0	35.8	31.8
West Bengal	45.5	44.1	44.1	44.1	47.0	54.2	3.9	50.6	52.8	58.0	58.5	61.4	60.4
Maharashtra	64.1	62.2	63.5	66.2	65.0	68.0	3.2	81.6	78.6	92.7	89.1	89.2	94.7
Andhra Pradesh	76.0	74.1	80.6	77.1	70.1	76.3	3.8	73.8	76.0	58.9	70.5	62.3	78.5
Karnataka	77.9	89.9	87.4	92.1	84.7	87.7	2.2	81.2	78.1	69.5	75.6	71.5	73.2
Tamil Nadu	86.7	78.2	79.4	79.9	75.7	77.4	2.6	84.2	98.3	91.0	93.0	99.2	104.6
Gujarat	58.5	52.2	50.0	47.7	50.8	51.8	3.8	47.1	50.2	49.0	55.2	55.4	56.2
Orissa	49.4	49.0	49.7	57.6	52.1	53.9	2.6	65.2	58.7	62.5	65.5	61.6	61.5
All India	43.7	40.3	46.7	49.2	49.1	48.3	7.5	50.9	51.2	49.9	50.9	53.6	56.4

of all expenses involved. The grower-members are paid at the time of delivery of cane an initial cash advance ranging from 80-90% of the commercial price of cane delivered. At the end of the season, when the books are closed and operating results are known, the balance of the commercial price is paid to the cane-grower members, subject to availability of funds. Often, due to non-liquidity cane payments remain in arrears. In Table 13, we have presented data on arrears of sugarcane dues Zone-wise as at the end of the 1978-79 sugarcane crushing season. This is primarily to draw attention to the dimension of the problem. It may be noted from the data while the percentage of arrears to dues is quite small (3.25%), the total amount remaining as arrears is quite substantial (Rs.21.14 crores).

5.9 The sugar cooperatives have provided an assured market and high price for cane. As a result sugarcane cultivation has become relatively more profitable. Further the cooperative movement has evolved an efficient system of crop finance for sugarcane. Also

continuous efforts are being made by the sugar factories through their agricultural departments, to introduce new technology and better farm practice among grower members. The factory has also played a major role in organising lift irrigation schemes and in developing roads and irrigation facilities. All this has resulted in a remarkable expansion of acreage.

6.0 Sugarcane Development

6.1 The success of the cooperative sector of the sugar industry has led to a rapid expansion of sugarcane acreage in the country. In fact, cane acreage shot up from 4.2 million acres in 1950-51 to 8.0 million acres by 1981-82. Thus, in three decades the area under cane has nearly doubled. Simultaneously, steady progress has been made in improving productivity. An idea of the pace of progress in area and yield may be had from data presented in Table 14. From the data presented in columns 3 & 9 it is evident that there is progressive improvement over time both in cane yield and sugar production per hectare of land under sugarcane.

6.2 It may further be noted from data presented in Table 15 that the progress in productivity is not confined to one or two states but is witnessed broadly speaking in most of the important cane growing states. This trend is still continuing.

6.3 A remarkable feature of cane development is that the acreage under cane is expanding relatively more rapidly in the tropical states. The supporting data have been presented in Table 16. From the data it is very clear that the linear annual growth rates of area, production and price for cane received by farmers, show steady increase and that the growth rates are relatively larger in the case of tropical states of Andhra Pradesh, Maharashtra, Tamilnadu and Karnataka. The some what slower rate of increase in acreage of cane in Maharashtra is accounted for by the severe limitations of acreage in the state and state policy on irrigation. A welcome feature of this development is that the regional disparity in cane acreage which was an accident of history is being gradually rectified.

6.4 Historical, the cane crop was first developed in the sub-tropical states of U.P. and Bihar. The first factories were also established there due to availability of cane supplies. Consequently when protection was extended to the sugar industry in 1932 AD the sugar industry developed rapidly in this area and cane development also followed. In fact, initially sub-tropical states accounted for 80% of national sugar production and 85% of national cane acreage (see Table 17).

A remarkable feature of cane cultivation in the sub-tropical belt was that the cost of production was

Table 13
The Zone-wise Arrears of Sugarcane Dues
at the end of 1978-79 Season (Rs. in crores)

State	Total Cane price due	Total Arrears	Percentage of arrears to due
Andhra Pradesh	36.45	0.52	1.43
Assam	1.52	0.03	1.97
Bihar	32.86	2.56	7.79
Goa	0.86	--	--
Gujarat	13.04	0.73	5.60
Haryana	14.97	0.04	0.27
Karnataka	53.50	2.26	4.22
Kerala	3.53	0.38	10.76
Madhya Pradesh	6.44	0.81	12.58
Maharashtra	227.35	2.21	0.97
Nagaland	1.19	0.002	0.17
Orissa	2.62	0.001	0.04
Pondicherry	3.30	0.02	0.61
Punjab	11.23	0.10	0.89
Rajasthan	3.67	0.12	3.27
Tamil Nadu	61.60	0.65	1.06
Uttar Pradesh	174.46	10.65	6.10
West Bengal	1.31	0.05	4.58
All India	648.90	21.143	3.25

low and so was the yield per acre. This was primarily because sugarcane was raised as a non-irrigated crop with low level of inputs. However, when the sugar industry developed in the tropical states of South India due to climatic suitability, development of irrigation resources, a steady demand for sugar in the domestic market and encouragement by state governments and the central government, it was relatively more

efficient both in the field and in the factory. And all of a sudden the sugar units in the sub-tropical belt found themselves to be high cost units. The divergence in the cost structure is reflected in the data presented in Table 18. The data is zone-wise.

6.5 From the data presented in Table 18 a summary table indicating the range of variation in cost has been prepared and is presented in Table 19. The mean

Table 18
Statement Showing Zone-wise Unit Cost 'L' Per Quintal of Sugar (D-29 Grade) for Different Seasons
Announced by Department of Food

Zones	1974-75 Announced Vide L. No.	1975-76 Vide No.	1976-77 Vide No.	1977-78 Vide No.	1978-79 Vide No.	1979-80 Vide No.	1980-81@ Vide No.	1981-82@ Vide No.
	15-5/75- Spy. date 29.9.75 Deptt. of Food	3-8/76- Sy. Date 6.10.76	3-5/77- Spy. (D-II) date 28.6.78	3-3/79- Spy. (D-I) date 19.4.79	3-16/79- spy. (D-II) date 6.12.80	3-16/80- Spy. (D-II) date 28.1.81	3-11/81- Spy. (D-II) date 18.2.82	3-5/82- Spy. (D-II) date 14.1.83
Punjab	171.18	189.69	174.77	187.96	207.72	267.11	391.44	281.20
Haryana	170.92	181.72	182.52	203.47	223.53	264.02	339.78	312.98
Rajasthan	192.43	201.85	200.50	212.64	235.50	304.13	328.12	345.95
West U.P.	163.78	184.35	175.72	190.13	216.69	261.66	302.11	281.68
Central UP	172.53	179.11	176.24	192.60	223.34	263.33	302.15	312.02
East UP	194.09	202.79	189.36	202.48	238.58	296.39	330.55	307.95
North Bihar	206.48	210.86	205.70	206.32	241.37	264.07	331.75	309.23
South Bihar	338.68	236.96	235.03	251.83	277.87	325.83	360.79	357.33
Gujarat	176.04	180.87	178.25	184.22	213.90	255.86	287.32	288.65
M. P.	194.64	195.53	207.40	201.58	232.42	316.72	390.69	350.18
Maharashtra								
-shtra	167.99	173.37	182.62	179.96	208.86	268.61	273.90	287.83
Karnatak	171.51	189.95	192.08	190.76	224.19	302.56	284.87	280.90
A. P.	162.59	178.79	191.65	186.82	224.37	295.26	304.36	304.24
T. Nadu								
Pondi- cherry	189.02	206.09	197.66	194.90	228.96	273.00	312.83	301.26
Assam, Orissa, W. Bengal & Nagaland	197.62	202.16	197.13	210.25	236.02	286.37	339.42	328.81
Kerala & Goa	194.56	209.74	204.81	200.37	229.79	290.42	314.28	311.86

@ The prices quoted in 1980-81 are of D-30 grade of sugar which is higher by 85 Paise per quintal than that of D-29 grade of sugar.

range of variation in cost was found to be Rs.84.41 while the median was found to be Rs.71.01. Thus the variation in cost is seen to be significantly large and there is need to adopt a long term policy to rectify the situation.

6.6 The regional disparity in cane acreage cannot be rectified. In fact, as Dr. S.N. Gundurao has rightly pointed out, even if all the facilities are extended to cane development in the tropical South, that region

Table 17
Distribution of Area under Sugarcane
(1950-51)

State	Cane area of State as % of national cane area	Percentage of cane area that is irrigated
Sub-Tropical	85.0	--
Uttar Pradesh	59.4	65.5
Punjab	8.8	72.7
Bihar	9.7	23.9
Others	7.1	40.0
Tropical	15.0	--
Maharashtra	4.4	100.0
Andhra Pradesh	4.2	100.0
Tamil Nadu	2.9	97.0
Karnataka	3.5	87.0

would not be able to increase cane area to an extent necessary to correct regional disparity because of inherent scarcity of cultivable areas and the demand for land by other competing agricultural crops in that region. Hence the only feasible long term solution to the problem of disparity is to improve the productivity and efficiency of the sugarcane and sugar industry in Northern India. That this is necessary may be observed from data presented in Table 20. The data emphasises the need for greater use of irrigation and manure in the Northern states of U.P., Bihar and Punjab as that their lag in sugarcane yield and productivity may be made up.

6.7 Steps have already been initiated for cane development in U. P. and Bihar. This is seen from the amount of purchase tax on cane utilised by the state governments for cane development. It may be seen from data presented in Table 21 that the states of U.P. and Bihar are pumping massive resources into the cane development programmes. Of late the state government of Andhra Pradesh and Tamilnadu are also seen to be paying greater attention to cane development. All this should help to reduce the regional disparity.

6.8 The states of Punjab and Haryana have adopted the strategy of introducing high sucrose varieties of cane to improve productivity of cane. This strategy has succeeded and the recovery of sugar which was ranging between 8&9% in these two states is now consistently 9.5% or more. Andhra and Tamilnadu have adopted this strategy successfully. Of course this is possible when cane varieties suitable for specific

Table 16
Linear Growth Rates of Area, Production and Prices during 1964-65 to 1975-76

State	Percentage of sugarcane production in the State to all India (1976-77)	Percent growth rates of				
		Area	Production	Cane Price	Gur Price	Competing crop price
Tropical States	35.05					
Andhra Pradesh	6.83	2.13	0.65	8.11	5.19	1.31
Maharashtra	13.96	1.41	4.95	9.45	29.06	18.23
Tamil Nadu	8.54	5.00	6.10	11.46	32.08	2.56
Karnataka	5.72	5.61	3.98	4.35	4.36	5.22
Sub-Tropical States	50.77					
Uttar Pradesh	44.22	1.33	2.22	7.64	9.47	8.55
Bihar	2.71	-1.42	-0.83	5.76	15.18	8.93
Punjab	3.84	3.45	2.23	6.07	9.62	8.97

Table 20

Yields of Sugarcane in a few selected States with varying input parameters

State	Crop duration (days)	Irrigation applied approx. (in cm)	Average N applied (kg/ha)	Average yields (t/ha)	Recovery (%)	Sugar Production (t/ha)
Uttar Pradesh	360	40	0-100	39	9.45	3.69
Bihar	360	40	0-175	37	9.59	3.55
Punjab	360	75	0-100	38	9.69	3.29
Karnataka	360	150	200-300	81	10.59	8.59
	450	175	200-300	100	10.59	10.59
Andhra Pradesh	360	100	100-250	80	9.62	7.70
	450	125	100-250	100	9.62	9.62
Maharashtra	360	235	350-450	80	11.77	14.13
	540	300	350-450	150	11.77	17.65

Table 21

State-wise Amount of Cane Cess/Purchase Tax Collected and Spent on Cane Development (Rs. in lakhs)

State	1960/61	65/66	69/70	70/71	71/72	72/73	73/74	74/75	75/76	76/77	77/78	78/79	79/80
Andhra Pradesh	65 (28)	102 (51)	144 (59)	97 (51)	162 (65)	172 (64)	261 (48)	N.A. (N.A.)	412 (22)	285 (38)	313 (36)	250 (56)	281 (140)
Bihar	84 (23)	170 (24)	164 (41)	198 (46)	217 (52)	218 (35)	215 (34)	251 (43)	220 (97)	249 (108)	312 (113)	291 (132)	181 (130)
Uttar Pradesh	426 (89)	683 (115)	590 (181)	679 (164)	461 (210)	624 (362)	706 (277)	880 (373)	1253 (216)	1201 (N.A.)	1526 (411)	1398 (92)	1787 (857)
Punjab	14 (9)	15 (N.A.)	N.A. (5)	13 (2)	8 (N.A.)	7 (N.A.)	N.A. (N.A.)	N.A. (N.A.)	N.A. (N.A.)	N.A. (N.A.)	N.A. (N.A.)	24 (33)	N.A. (N.A.)
Haryana	-	-	16 (7)	38 (8)	49 (3)	53 (N.A.)	62 (4)	107 (44)	124 (36)	141 (14)	N.A. (N.A.)	47 (2)	229 (183)
Maharashtra	133 (6)	232 (16)	414 (34)	454 (12)	542 (32)	786 (33)	725 (33)	993 (N.A.)	1712 (N.A.)	1781 (36)	N.A. (N.A.)	2956 (18)	2255 (N.A.)
Karnataka	N.A. (N.A.)	119 (3)	152 (5)	163 (6)	184 (14)	N.A. (N.A.)	290 (N.A.)	428 (7)	N.A. (N.A.)	N.A. (N.A.)	N.A. (N.A.)	N.A. (N.A.)	232 (15)
Tamilnadu	21 (15)	76 (27)	250 (50)	209 (56)	284 (57)	N.A. (N.A.)	N.A. (N.A.)	292 (60)	375 (110)	465 (120)	126.4 (148.4)	596 (110)	36 (150)
Madhya Pradesh									17	15	8	N.A.	

Figures given in the brackets show amounts on cane development.
Purchase tax collection figures not available.

needs are developed commercially. Fortunately, in India the infrastructure for developing new cane varieties is well developed and suitable varieties are developed and recommended for commercial use in the different sugarcane states. The varieties of canes recommended and adopted for commercial exploitation by different states are listed state-wise in Table 22.

Table 19
Range of Variation in Zonal Unit
Cost 'L' Per Quintal of Sugar
(1974-75 to 1981-82)

Year	Unit Costs (Rs. Per Quintal)		
	Minimum	Maximum	Range
1974 - 75	162.59	338.68	176.09
1975 - 76	173.37	236.96	63.59
1976 - 77	174.77	235.03	60.26
1977 - 78	179.96	251.83	71.87
1978 - 79	207.72	277.87	70.15
1979 - 80	261.66	325.83	64.17
1980 - 81	273.90	391.44	117.54
1981 - 82	281.68	357.33	75.65

6.9 Cooperative sugar factories, being organisations of farmers, have a natural bias in favour of agriculture. Consequently it is not at all surprising if they pay special attention to cane development and to improvement in the productivity of land. However the success of the factories in cane development should not blind us to their equally great success in manufacturing sugar. In fact the cooperatives have been eminently successful both in the field and in the factory.

7. Factory Efficiency

7.1 One of the indicators of efficiency in the factory is the degree of utilisation of capacity. We had remarked on an earlier occasion in para 4.1 that the sugar industry had consistently exceeded the production targets prescribed for it by the Planning Commission. This was due not only to the success of the industry in converting licences into installed capacity speedily but also due to their ability for efficient utilisation of installed capacity. Capacity utilisation is measured by expressing the actual production achieved by a factory in crushing season as a percentage of the factory's capacity to produce sugar. The Government of India takes the annual sugar production figures for a factory of 1250 TCD in different states for computing annual sugar production capacity.

State	Annual Sugar Production Capacity Tonnes
Andhra Pradesh	13,000
Haryana	13,000
Uttar Pradesh	14,000
Punjab	11,000
Gujarat	19,500
Karnataka	17,500
West Bengal	10,000
Kerala	10,000
Madhya Pradesh, Orissa, Rajasthan	9,000
Assam	7,000
Pondicherry	15,000
Bihar	12,000
Maharashtra	20,000
Tamilnadu	18,000

The data on capacity utilisation has been presented in Table 23. It is self evident from the data that in the case of more than 30% of the factories capacity utilisation percentage was more than 100 in the year 1980-81 indicating the high efficiency of the industry. The highest efficiency has been recorded by Maharashtra where cooperative sugar factories dominate the scene.

7.2 In this context it may be noted that capacity utilisation is usually low in the initial stages and the factory becomes fully efficient only in the fourth year of operation. For the purpose of providing excise rebate on production in excess of rated annual production, Government authorities assumed the following percentage utilisation of capacity in the case of new sugar units.

Year of Crushing of Capacity	% Utilisation of Capacity
1st	70
2nd	85
3rd	90
4th	100

Consequently a large number of units in their first four years of operation are likely to be included in the capacity utilisation category 81-100%. In fact, a large number of units in the below 80% category are also newer units who have yet to develop cane

Table 23

Statement showing State-wise Number of Factories falling under different categories of Sugar Production Capacity Utilization

State	No. of working Factories		Less than 60%										60-80%	81-100%	101-120%	121-140%	141-160%	161-180%	Above 180%	Average %
80-81	79-80	80-81	79-80	80-81	79-80	80-81	79-80	80-81	79-80	80-81	79-80	80-81	79-80	80-81	79-80	80-81	79-80	80-81	79-80	80-81
Andhra Pradesh	13	13	12	9	1	3	-	1	-	-	-	-	-	-	-	-	-	-	26.66	38.13
Assam	1	1	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	122.79	58.41
Goa	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27.75	48.23
Gujarat	11	13	6	4	2	4	1	1	3	1	1	1	-	-	-	-	-	-	60.44	74.06
Haryana	4	4	4	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	47.03	60.73
Karnataka	13	13	9	8	3	-	1	2	3	-	-	-	-	-	-	-	-	-	49.06	71.54
Kerala	2	2	1	1	1	-	-	-	-	-	1	-	-	-	-	-	-	-	47.70	76.31
Madhya Pradesh	1	2	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11.53	27.58
Maharashtra	60	67	24	12	15	9	10	13	5	10	5	15	1	4	-	3	-	1	69.17	101.35
Orissa	2	1	1	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	52.27	108.77
Punjab	4	4	1	-	2	3	-	-	-	-	-	1	1	-	-	-	-	-	88.67	76.60
Rajasthan	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15.44	44.39
Tamil Nadu	9	10	4	4	3	4	1	1	1	1	-	-	-	-	-	-	-	-	63.88	62.84
Uttar Pradesh	16	17	10	8	2	3	1	4	2	1	-	-	-	-	-	1	-	-	58.08	69.41
Total	138	149	75	52	29	29	15	22	9	18	7	18	2	5	1	4	-	1	59.99	91.28

This shows that 39 Factories (excluding 13 new factories commissioned during 1980-81), in 1980-81 utilised their production capacity below 60%. Of them 8 each in Andhra Pradesh and Karnataka, 7 in Uttar Pradesh and the rest in other States. On an average production capacity utilisation percentage was highest in the States of Orissa 108.77 followed by 101.35 in Maharashtra. Lowest utilisation was in the States of Andhra Pradesh 38.13 and Madhya Pradesh 27.58.

acreage to sustain steady supplies of cane to the factory.

7.3 Another Index of Efficiency is the size of the labour force employed by the factory. There is general misconception that cooperative sugar factories suffer from feather bedding. However the statistical evidence is all to the contrary. In fact the cooperatives are employing a much smaller staff than the private or public owned units. The relevant data has been presented in Table 24.

It should be particularly noted that in Maharashtra and Tamilnadu where cooperative units are found in abundance and influence the state average of the number of employees per factory, the average number of employees was substantially below the national

Table 22

The list of Varieties being grown commercially in different States of India

State	Varieties
Uttar Pradesh	Co.1148, Co.1158, B.O. 17 B.O. 54, B.O. 70
Maharashtra	Co.740, Co.419, Co.775
Haryana	Co.1148, Co.975, Co.1158
Tamil Nadu	Co.419, Co.658, Co.6304, Co.449, Co.740, Co.6806, Co.853
Andhra Pradesh	Co.419, Co.997, Co.62175
Bihar	B.O. 14, B.O. 17, B.O. 70, B.O. 34, B.O. 29, Co.1158, B.O. 32, B.O. 3, B.O. 43, B.O. 72
Karnataka	Co.419, Co.740, Co.449
Punjab	Co.1148, Co.46, Co.1158, Co.64, Co.975, Co.58, Co.67
Madhya Pradesh	Co.419, Co.954, Co.678, Co.312, Co.421, Co.853, Co.1307, Co.290, Co.617, Co.313
Orissa	Co.419, Co.997, Co.881, Co.740, Co.527, Co.62175, Co.1053
Assam	Co.740, Co.313, Co.997, Co.961
Rajasthan	Co.419, Co.312, Co.1111, Co.1253, Co.449, Co.1007, Co.527, Co.29
Gujarat	Co.419, Co.775
West Bengal	Co.527, Co.62010, Co.1008, B.O.17, Co.419, Co.1132, Co.1232
Kerala	Co.997, Co.449, Co.419, Co.785, Co.349, Co.740
Nagaland	Co.419, Co.740, Co.421
Pondicherry	Co.658, Co.6304, Co.853

Table 24

Employment per Factory

(Data relating to the average number of employees per Factory during 1957-58 & during 1965-66)

State	1957-58*	1965-66
Andhra Pradesh	1,093	945
Assam	--	924
Bihar	1,134	1,044
Gujarat	545	620
Kerala	812	798
Madhya Pradesh	970	967
Maharashtra	840	871
Karnataka	1,172	921
Orissa	564	464
Pondicherry	--	546
Punjab	1,485	903
Rajasthan	837	960
Tamil Nadu	1,081	807
Uttar Pradesh	1,224	1,203
West Bengal	1,021	996
All India Average	1,114	1,009

* First Sugar Wage Board's Report

@From the replies received by the Second Wage Board

average of 1009 in the year 1965-66. The figure for Maharashtra and Tamilnadu were 871 and 801 respectively that year. Another thing to be noted is that between 1957-58 and 1965-66 the states of Andhra Pradesh and Tamilnadu were actually able to reduce the size of their labour force sizeably. And these are the states where the cooperative sector is well developed.

7.4 We have presented in Table 25 data regarding the composition of the work force. This is helpful in showing how sugar factories have created employment opportunities for skilled, highly skilled, supervisory, technical and professional and administrative and executive personnel in the rural areas. The data is self explanatory.

7.5 The Cooperative sector had a late start. But even this has proved to be advantageous to the cooperative units as thereby they have been enabled to install the most modern machinery and adopt the latest technical advances and operate larger units. Since

there are distinct economic of scale in the sugar industry, the larger units enjoy cost advantage over the smaller units. In fact, most of the larger units belong to the cooperative sector. In contrast the private sector suffers from the effect of obsolescence. They also have a large number of small, out-dated and uneconomic units. According to Dr. S.N. Gundurao in the sub-tropical northern states there were in the year 1969 as many as 115 factories which were more than 25 years old; 36 factories between 30 and 40 years old and 14 factories between 40 and 50 years old. Since then the situation has if any thing deteriorated. Hence there is need for a crash programme to modernise and rehabilitate these old, outdated and uneconomic units in the sub-tropical northern India. Such a programme supplemented by a vigorous cane development programme would help to solve the problem of regional disparity remarked upon earlier in this paper.

8. Utilisation of Sugarcane

8.1 The pattern of utilisation of cane has changed

significantly over the years. It may be noted that the proportion of cane utilised for the manufacture of sugar has increased from 28.2% in 1960-61 to 47.6% in 1981-82 while the percentage of cane utilised for the production of Gur and Khandsari has declined from 59.4% to 40.6% over the same period. This represents a significant shift in the structure of the industry, from gur and khandsari towards sugar. The relevant data has been presented in Table 26.

8.2 From the data in Table 26 it may be noted that the cane utilised for the production of white sugar has increased from 31.02 million tonnes in 1960-61 to 87.34 million tonnes in 1981-82. This is the result of increase in population from 362 million persons to 700 million persons over the same period, and increase in per capita consumption of sugar from 3 kgs in 1960-61 to 8.2 kgs in 1981-82 (see Table 27). A greater portion of this increased demand is met by the growth of the cooperative sector of the Sugar Industry.

8.3 From the data on population and per capita consumption of sugar, gur and khandsari it is clear that there is a steady rise in per capita consumption

Table 25

Composition of Employees in Different Categories (Percentage)

State	Un-skilled	Semi-skilled	Skilled	Highly skilled	Clerks	Super- visory	Techni- cal profe- ssional	Admini- strative and execu- tive	Others
Andhra Pradesh	44.3	18.9	12.1	2.3	13.4	1.9	0.9	0.4	5.8
Assam	61.4	14.9	4.8	2.8	15.0	0.9	-	0.2	-
Bihar	59.5	16.6	7.4	1.0	11.3	0.9	0.4	0.4	2.5
Gujarat	34.4	14.9	8.6	3.2	22.8	1.8	0.4	0.2	13.7
Kerala	36.8	19.9	12.1	2.6	11.0	1.8	1.0	3.0	11.8
M. P.	63.0	14.8	8.5	1.3	9.5	0.8	0.4	0.2	1.5
Maharashtra	46.2	21.0	12.8	1.7	12.3	1.6	1.1	0.5	2.8
Mysore	45.6	21.6	11.4	1.5	14.5	2.5	0.7	0.8	1.4
Orissa	36.7	26.8	16.4	1.9	14.1	-	2.7	1.3	0.1
Pondicherry	45.5	17.3	12.3	3.1	17.2	4.6	-	-	-
Punjab	48.7	21.7	8.7	1.9	14.6	1.4	0.6	0.4	2.0
Rajasthan	56.4	17.7	5.7	1.4	11.8	1.4	0.1	0.2	5.3
Tamil Nadu	46.9	16.9	12.6	2.7	14.3	1.9	1.2	0.8	2.7
U. P.	57.9	19.1	7.5	1.6	9.5	0.7	0.5	0.3	2.9
West Bengal	51.6	21.6	7.0	1.6	16.0	1.1	0.4	0.1	0.6
All India	53.1	18.9	9.3	1.7	11.6	1.2	0.6	0.5	3.1

of sweetening agents, the per capita consumption increasing from 12.5 kgs in 1960-61 to 19.1 kgs in 1981-82. There has been increase in per capita consumption of both sugar, gur and khandari. However growth rate of consumption of sugar is more rapid than that of gur and khandari. This in a way reflects the shift in consumption from gur to sugar and the main beneficiary of this shift in demand is the cooperative sector. For instance in Maharashtra the percentage of cane utilised for sugar production has gone up from 20% in 1950-51 to 63% in 1970-71 and today, it is nearly 70%. Thus the percentage of cane utilised for sugar is steadily moving up with the growth of the cooperative sector

of the sugar industry.

In fact, the high proportion of cane utilised for the manufacture of gur and khandari represents the potential for growth of sugar industry and establishment of new sugar units. In fact, it opens up a new vista of rural industrialisation and area development. Hence, the long term policy should be to encourage shift in consumption from gur and khandari to white sugar.

9. Project Costs

9.1 Over the years the cost of setting up a new sugar factory has steadily moved up. The total

Table 26
Utilisation of Sugarcane for Different Purposes

	Production of sugar cane ('000 tonnes)	Cane used for ('000 tonnes)			% of sugarcane production utilised for		
		Production of white sugar	Seed, food & chewing etc.	Gur and Khandari	Production of white sugar	Seed, feed & chewing	Gur and Khandari
1960-61	110,001	31,021	13,620	65,360	28.2	12.4	59.4
1961-62	103,967	27,946	12,743	63,278	26.9	12.2	60.9
1962-63	91,913	20,799	11,157	59,957	22.6	12.1	65.3
1963-64	104,225	25,716	12,535	65,974	24.7	12.0	63.3
1964-65	121,909	33,454	14,539	73,916	27.4	11.9	60.7
1965-66	123,909	36,512	14,606	72,872	29.4	11.8	58.8
1966-67	92,826	21,637	11,094	60,095	23.3	12.0	64.7
1967-68	95,500	22,638	11,234	61,628	23.7	11.8	64.5
1968-69	124,676	37,699	14,734	72,243	30.2	11.8	58.0
1969-70	135,024	45,721	16,291	73,032	33.9	12.1	51.0
1970-71	126,368	38,205	15,173	72,990	30.2	12.0	57.8
1971-72	113,569	31,015	13,514	69,040	27.3	11.9	60.8
1972-73	124,866	40,407	14,999	69,460	32.4	12.0	55.6
1973-74	140,805	42,278	16,802	81,725	30.0	11.9	58.1
1974-75	144,289	48,435	17,188	78,666	33.6	11.9	54.5
1975-76	140,604	41,880	16,692	82,032	29.8	11.9	58.3
1976-77	153,007	48,819	18,374	85,874	31.9	12.0	56.1
1977-78	176,966	67,329	21,029	88,608	38.0	11.9	50.1
1978-79	151,655	59,717	17,934	74,004	39.4	11.8	48.8
1979-80	128,833	39,050	15,104	74,679	30.3	11.7	58.0
1980-81	154,248 *	51,584	18,201	84,463	33.4	11.8	54.8
1981-82	183,647 *	87,342	21,670	74,635	47.6	11.8	40.6

* Partially revised estimate
@ Provisional

Table 27

Per Capita Consumption of Sugar, Gur & Khandsari

Sugar Season	Population in Million (as on 1st March)	Consumption (Lakh tonnes)		Per Capita Consumption (Kgs. per annum)		Total Consumption (Kgs. per annum)
		Sugar	Gur & Khandsari*	Sugar	Gur & Khandsari	
1950-51	362	10.98	34.29	3.0	9.5	12.5
1951-52	367	11.82	33.63	3.2	9.2	12.4
1952-53	373	16.79	27.72	4.5	7.4	11.9
1953-54	379	18.36	26.13	4.8	6.9	11.7
1954-55	385	17.51	31.03	4.5	8.1	12.6
1955-56	398	19.72	30.29	5.0	7.7	12.7
1956-57	400	20.18	51.00	5.0	12.7	17.7
1957-58	410	20.75	53.00	5.1	12.9	18.0
1958-59	420	21.13	56.71	5.0	13.5	18.5
1959-60	428	20.53	56.21	4.8	13.1	17.9
1960-61	439	21.13	66.87	4.8	15.2	20.0
1961-62	448	25.88	64.32	5.8	14.4	20.2
1962-63	458	24.86	60.74	5.4	13.3	18.7
1963-64	468	23.07	66.67	4.9	14.2	19.1
1964-65	478	24.69	72.05	5.2	15.1	20.3
1965-66	489	28.10	69.11	5.7	14.1	19.8
1966-67	500	26.01	61.25	5.2	12.2	17.4
1967-68	511	22.15	63.05	4.3	12.3	16.6
1968-69	523	26.05	73.46	5.0	14.0	19.0
1969-70	534	32.64	74.01	6.1	13.9	20.0
1970-71	546	40.25	74.37	7.4	13.6	21.0
1971-72	558	37.95	69.98	6.8	12.5	19.3
1972-73	570	35.14	70.30	6.2	12.3	18.5
1973-74	581	35.22	83.36	6.1	14.3	20.4
1974-75	593	34.75	80.63	5.9	13.6	19.5
1975-76	609	36.89	83.67	6.1	13.7	19.8
1976-77	621	37.57	88.41	6.0	14.2	20.2
1977-78	633	44.82	90.88	7.1	14.4	21.5
1978-79	646	62.14	75.96	9.6	11.8	21.4
1979-80	669	52.08	75.48	7.8	13.3	19.1
1980-81	684	49.80	86.33	7.3	12.6	19.9
1981-82@	700	57.11	76.11	8.2	10.9	19.1

@ Estimated Population

* Entire annual production of Gur & Khandsari is taken as consumed internally

project cost which was around Rs.1 crore in the fifties rose to Rs.1.60 crores in early sixties and Rs.2.20 crores in the late sixties. In the seventies there was a big quantum jump in the project cost, the cost reaching a level of Rs.3.75 crores by 1973. Thereafter, there has been a steady increase. The costs rose to Rs.7.50 crores towards the end of the seventies and today it is around Rs.9.50 crores.

9.2 The rise in project costs has hampered the rapid growth of the cooperative sector, particularly as the financial institutions insist on a debt-equity ratio of 60:40. This means that to set up a new cooperative sugar unit, a sum of Rs.3.80 crores have to be raised by way of share capital. This is an almost impossible task if all the money were to be raised from grower members. Hence to encourage the growth of cooperative sugar industry, a pattern of financial aid had to be devised. According to this pattern the grower-members raise approximately Rs.70 lakhs by way of share capital. The grower-members can borrow upto 75% of the face value of the shares through the cooperative credit structure. The state government pitches in with Rs.100 to 110 lakhs as contribution. Balance of share capital is made up by a contribution from NCDC. Thus the government, the financial institutions and other development agencies have joined hands to encourage the growth of the cooperative sector of the sugar industry.

10. Contribution of Sugar Cooperatives

10.1 To begin with the sugar cooperatives have provided an assured market and remunerative price for sugarcane, thus ensuring profitability for the cane growers. They have also taken active steps for cane development and for introduction of sound agronomic practices. They have also helped to organise crop finance to ensure use of higher inputs and regular recovery of loans through integrated credit system. They have also helped to mobilise human, natural and financial resources to create income and employment opportunities in the rural areas.

10.2 The cooperative sugar factories have played a positive and effective role in stabilising sugarcane and sugar production and hence agricultural incomes in their area of operation. This has been done through development of irrigation resources and assuring a steady market and remunerative prices for sugarcane.

10.3 The sugar cooperatives have played a very active role not only in rural development but also in ensuring balanced regional growth. They have also helped to open up backward areas by locating sugar factories in such areas.

10.4 The sugar factories have established a remarkable record of technical efficiency and ensured profitable

utilisation of cane. This is because the factory sector is substantially more efficient than the gur and khandsari industries.

10.5 The sugar cooperatives have played a significant role in the transformation of rural society. Because of their philosophy and ethical values the cooperative managements pay special attention to the weaker sections of the society viz. the small farmers, agricultural and factory labour, the oppressed and depressed classes, the backward classes, etc.

10.6 The sugar cooperatives have played a very significant role in creating in the rural areas infrastructure facilities and social overheads necessary for improving the quality of life and standard of living of the masses. Thus they helped develop irrigation resources, road net work, educational and health facilities and provide housing for the poor. In times of natural calamities like flood, famine, drought, they have contributed generously for relief funds and have also organised relief in their area.

10.7 The sugar cooperatives do not exploit either the consumer or the factory labour. They have always been conscious of their social responsibilities and have behaved in a responsible way in times of crisis.

10.8 Hence the conclusion is inescapable that the sugar cooperatives have proved a boon to the rural areas. As we had remarked in para 1.1 the cooperative movement has many facets and no where is this more evident than in the working of sugar cooperatives. Maharashtra Sugar Cooperatives are a glowing example.

SHRI MADHI VIBHAG KHAND UDYOG SAHAKARI MANDALI LTD. MADHI.

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At & Post MADHI 394 340
Tal. Bardoli, Dist. Surat
(Gujarat State)

- Registration No. : SE-9
- Year of Establishment : 31st March, 1964
- Production Started : 1968-69 Season
- Total No. of Members : 10 206
- Share Capital : Rs. 93.45 lacs.
- Crushing Season 1984-85 :
 - Crushing Capacity : 3500 MT per day
 - Cane Crushed : 4,66,319.400 MT.
 - Sugar Production : 5,22,170.00 Quintals
 - Recovery : 11.14%

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PURUSHOTT AMN AG AR
Tal. Shahada, Dist. Dhule

Cooperation is the basis of a well organised Society
Sugar is essential in our Daily Life
We produce brilliant white Crystalled grained sugar for you

SALIENT FEATURES

<u>Year</u>	<u>Cane crushed M. Tonnes</u>	<u>Sugar bags produced</u>
1985-86	4,60,858	5,00,340

Our crushing target for 1986-87 season is about 5,60,000 T. and expecting 6,20,000 bags of sugar. Government of Maharashtra has granted permission to our Factory for lifting water from Tapi River for 34 Lift Irrigation Schemes and for one Lift Irrigation Scheme on Gomai River, out of which, 14 lifts have been commissioned. After completion of all these schemes nearly 30,000 acres of land will be irrigated. We are trying our level best to complete all these schemes.

Our Karkhana received licence for 50 M.T.P.D. writing and printing paper production.

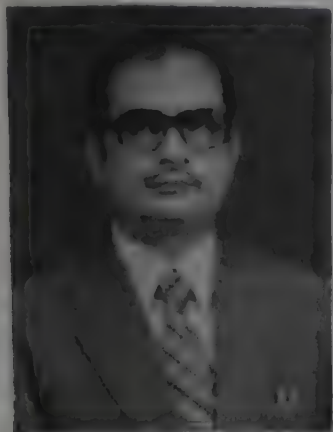
Ancillary Unit	...	Distillery
Capacity	...	45,000 Ltrs. a day
Alcohol in production from	...	1.2.1975.

"MAHARAJA" Brand Quality Country Liquor in production from 8.3.1975. The first plant in Maharashtra for production of Mahuwa quality Country Liquor. Also started Commercial Production of Indian made Foreign Liquor.

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Chairman



IMPACT OF SUGAR POLICY

MYDUR ANAND

Sugar Industry Consultant

26, Crescent Road, Bangalore 560 001

Sugar industry is known to be the 2nd largest industry in the country the largest provider of employment as also the industry which contributes most to the rural prosperity and development. Over two decades ago, the SEN Commission referred to each sugar factory as 'a rural development centre' and perhaps, its involvement in today's context of 'anti-poverty' and 'intensive rural development' thrusts is all the more direct and pertinent.

As many as 400 (nearly) factories dot the map in almost every region and state ! As in other activities, there are areas where sugar industry is concentrated more than in other areas. Being purely dependent on availability of its raw material, sugarcane, in its very neighbourhood, the industry is naturally concentrated where cane cultivation has been found feasible and made possible.

The constant demand for setting-up of more sugar factories in all regions, inspite of their wide disposal is an indication of its significance to and acceptance of its pertinence to rural development and general prosperity. Consequently, the overall performance of the sugar industry, particularly with reference to its impact on social wellbeing, is critically viewed by the sensitive public and particularly so by the vociferous sections of urban societies, industrial and workers groups etc. Cost of sugar has been given a high weightage (perhaps, unduly high) in the formulae prescribed for working out the indices of costs of living of industrial workers etc. etc. Public's reactions to price levels and availability of sugar (occasionally about its quality) are indeed responsible for the government interesting itself, more than in any other industry, in regulating almost every aspect of the sugar industry, such as regulation of cane supplies, pricing of sugarcane and sugar, quality, storage and release of sugar (almost right upto retail marketing), control over price and distribution of molasses and alcohol, regulation of industrial wages etc. The import or export of sugar is entirely managed by the public sector. The financing of sugar industry, be it for financing new project implementation or for credit facilities for purchase of cane, stocking of sugar etc. are severely controlled by Financial Institutions and Banks under overall directions

from Reserve Bank of India. Perhaps, there is no other industry, outside the purely public sector, which is so severely regulated. Even with regard to sale of the so-called "FREE QUOTA SUGAR", its release, movement, trading and stocking by traders etc., the regulations are so severe and effective that the only element of speculation left in helping market sentiments, is the likely size of the sugar release for the next month ! There are obviously more restrictions on the sale of 'free' sugar than on the trade and movement of 'levy' sugar !

Policy Pillars

The main policy thrusts which govern the functioning of the industry can be listed as under :

- (i) Pricing of Sugarcane
- (ii) Pricing of Levy Sugar
- (iii) Levy Quota
- (iv) Release policy of free sugar
- (v) Pricing, control and release of molasses/alcohol
- (vi) Fiscal policies of special significance to sugar industry -
 - (a) Excise duties
 - (b) Incentives
 - (c) Extent and cost of credit
 - (d) Financing and regulation of stock etc.
- (vii) Import and Export of Sugar
- (viii) Wage Policy
and, of course
- (ix) Licensing of Additional production capacity -
new units and expansion.

Sugarcane Price Fixation

This perhaps has the greatest and imminent impact on production and profitability. But also, the most controversial ! The Government of India (GOI) in the Ministry of Food (MOF) fixes what is known as the "Basic Minimum Price of Cane". This is based on the recommendations of the Commission of Agricultural Prices and Costs (earlier APC). This price has no practical significance on the actual price payable but vitally affects the profitability as this fictitious price forms the basis of determination of regulated price of levy sugar. As 55% of production is to be sold at this price, the basic minimum price of cane, though fictitious in a way, has much practical significance.

It is not feasible to explain here the factors taken into account while fixing this price and the implications of the same on the welfare of the industry. It suffices to say that inspite of expert opinion of the COMMISSION, GOI decides the price mostly on political considerations. The poor level and the ineffective annual increase of this price by Rs.5 per ton during the last 5 years have primarily been responsible for the fall in production and the sickness of the industry. The sudden increase of Rs.25 per ton, during 1985-86 cannot be explained, except as a consequence of political compulsion. This substantial increase, coupled with the increase of 10% in free sugar quota, has no doubt helped increase sugar production during 1985-86. Yet, it has been short of economic necessity as is indicated by the lack of the big-spurt in cane acreage which should have been the natural consequence. The prospects for 1986-87 have shown no improvement. Obviously, the steep increase of Rs.25 per ton for 1985-86, with another Rs.5 for 1986-87, the cane price carries no incentive for intensive planting.

Bhargava Formula

This is perhaps the most insupportable suggestion, if not a totally misleading caricature ! Everyone had praise for it when it was announced, hoping that uncertainties and agitations for fixation of actual/final cane price, would end.

The basic minimum price of cane was only a notional concept, to workout the levy sugar price. The actual/final cane price to be paid is intended to include a share of the excess realisation obtained by the factories by the sale of free sugar at higher price levels. Bhargava Commission decided that the sharing should be on 50 : 50 basis between farmers and factories. But the formula suffered early demise, due to irrational cane price policy followed by Government of India. The basic minimum price continued to be pegged so low that even if the excess realisation was passed on to the farmers in toto i.e. 100 against 50% as per Bhargava formula, the final cane price would work out far below the cost of production of cane ! As Bhargava formula could not be adopted, the explosive matter of finding a balance passed on to State Governments which started announcing adhoc final cane prices, the so called State Advised Prices. This indeed saved the situation, which otherwise could have led to a law and order problem on the national level. It is reprehensible that Union Government and State Governments should be at loggerheads at fixing cane price but it was inevitable. Even though the basic minimum for 1985-86 was raised by Rs.25 a ton, it is still short of ushering in the Bhargava Formula. Yet, the Government of India swears by the Bhargava formula and notifies the price payable for cane by each factory as per formula. Inspite of the fact that

every factory has paid a much higher price - year after year ! How long could this paradoxical predicament go on ! Government of India could as well announce the abandonment of the formula.

Levy Sugar Pricing

Unfortunately, the Government has not made any departure from the basic pattern of fixing levy sugar prices on considerations of zonal average performance. Everyone realises that the present system is not helpful but both the industry and the Government are nervous of a change as it will upset the balance (!), whatever it is. The concept of zonal averages of the duration of season-recovery as well as costs of production is so undependable and devoid of any close uniformity expected of zonal considerations ! The author had earlier suggested grouping of factories into brackets of duration and recovery for determining the levy price. The costs are to be based on national averages and the variation between levy prices of one group of factories and another should not vary close to about 15% considering the all-India average. Afterall, 45% of sugar is sold now in free market where prices in different regions, regulated by market situation, do not vary even 10% from the national average. It is beyond reason to offer a group of factories a price level which is about 150% of the average and penalise certain other factories.

Government of India must embolden itself to get out of this rut which is justified only on considerations of historicity ! The present policy helps only those units whose general performance is above the average, thus denying the below average ones any chance of redemption. Units below the average are to suffer in perpetual disadvantage.

Levy-Free Quota

For many years, factories have been required to sell about 2/3 of production (65%) at fixed prices for public distribution to mainly urban citizens, and organised industrial workers. Workers in organised sector can no more be grouped under 'weaker sections of public'. Quite a number of them are finding citation in the 'well-off' lists of companies i.e. earning about above Rs.36,000 per annum ! Levy sugar rarely reaches the rural public and unorganised workers even in urban areas. Yet, the levy quota and distribution is continued. Perhaps it reduces the cost of Living Index and hence the DA payable !

From September 1985, the levy quota has been reduced from 65% to 55%. There is some arbitrariness in this. Government needs about 42 lakh tons for public distribution, armed forces etc. Under the present system, during the years when production is low, the Government cannot be sure of adequate supplies to meet the demands of public distribution system. There

is a demand by the industry to reduce levy quota to 50%. The Government shall be required to import the needs.

The author has elsewhere made a novel suggestion. Each factory's quota of levy supply should be fixed at 55% of its own average production over the prior 3 or 5 years. All excess production should be allowed to be sold in the free market. This provides a very attractive incentive for higher production, while at the same time the government is ensured of its needs of levy quota. This should be welcomed by the industry too as it is the best way of encouraging higher production!

Sugar Release Policy

From out of the seasonal nature of the industry, the necessity arises of production during 4-6 months and stocking for 10-15 months. The sale is strictly regulated by Government of India under the Sugar Control Order. Each factory is given a monthly quota for sale of both levy and free quota sugar. It baffles one to grasp that even 'free' sugar sale is restricted! It could as well be 'freed' from release control. Factories could regulate their own sale of free sugar. Perhaps NAFED & ISMA could adopt informal regulations. But surprisingly, the spokesmen of free enterprise themselves demanded atleast 'release control' when the Janata Government during 1977-78 abolished all controls over sugar. As the dual pricing policy (i.e. levy and free) has proved beneficial, it is not advisable to scrap the same. But, atleast the 'free' sugar could be taken out of the 'release controls'. However, it should be done only when the industry gears itself for voluntary regulation.

Though the restrictive release and movement control mechanism has come in handy in regulating the price fluctuations and excessive speculation, it has to be admitted that it has proved itself more to the benefit of sugar trade than sugar producers. Being sensitive to price increase of even 'free' sugar in places like Delhi, more so when the parliament is in session, Government of India indulges in ad-hoc releases of sugar in addition to the monthly release quota. This upsets the market sentiment - even a mere threat of adhoc release - and the dealers depress the prices in the wholesale market. Soon after, the prices go up. Neither the industry nor the consumer benefits

The most sensible method would be to fix up the monthly quotas at the end of the main production period say April/May when one is almost sure of the national production and sugar available for servicing the free market. The release for each month could vary marginally, taking into account festival times etc. But, the quotas once fixed and announced should

be adhered to. Government should allow the market to reach its own equilibrium and not upset the same by threats and adhoc releases. To repeat, such threats only help speculators and the industry.

Molasses Control

Control over distribution and price of molasses is a hangover from the days of PROHIBITION, which itself was introduced not so much for moral considerations but as a form of tribute to the memory of Mahatma Gandhi ! Over the years, the national leadership has moved away from the Gandhian path and PROHIBITION is no more talked about. Each State Government is keen on making more money by sale of liquors. Liquor and, even illicit liquor is available easily and in plenty everywhere but the control over molasses continues in violent contrast.

Making molasses available at cheap rates to keep liquor prices low is indefensible. The downstream products of industrial alcohol - mainly polythene, PVC, Synthetic rubber, a few non-essential 'drugs' etc. have no pertinence to the common man's needs. It is just baffling why molasses should be made available cheap to help such industries. Moreover, the cost of alcohol forms only a negligible part of the cost of the final consumable products ! The present price of molasses - six paise per kilo of molasses containing over 56% sugars - does not cover even the cost of storage and handling. There should be no hesitation or delay in the removal of all restrictions on price and movement of molasses. Even at one rupee a kilo, molasses would form an economic cattle feed. The extra income to the industry should result in sugar becoming cheaper by fifty paises a kilo. At present, the topsy-turvy controls result in making liquors cheap and sugar costly !

In defence of removing controls over storage and transport of molasses, we can aver that the illicit alcohol industry is resourceful enough to procure its raw material inspite of controls over molasses. So, removal of molasses controls in no way bothers or aids illicit distillation, which is the only argument against the lifting of controls.

But the alcohol lobby, though a progeny of the sugar industry, itself has developed vested interests and is opposing the lifting of controls ! Abolition of controls on molasses shall greatly encourage larger production of sugar and molasses which is of great significance to the prosperity of alcohol industry.

In Brazil, producers of cane or of molasses, get paid on the basis of sugar content. So, under identical costs, molasses should cost Rs.2.00 per kilo (against the average levy price of Rs.3.80 per kilo of sugar, ex-factory basis). At present, it fetches 6 paise at which price even garbage cannot be available !

Fiscal Policies

There aren't many areas where taxation, levies etc. deserve any special mention in the context of the sugar industry. What is of significance to the industry is the credit policy and the rates of interest thereon. Industry circles rightly feel that the credit limits should be elastic and not determined on the extent of credit drawn in the previous year. After all production levels vary widely and most often, it cannot be forecast as it largely depends on the pricing policy and the weather conditions both of which are fickle!

It is also unfair to expect the industry to bear the burden of interest on levy quota sugar which really belongs to Government. Though limited provision is made in the pricing formula, the actual burden is often larger. As in the case of buffer stocks, the government should reimburse - and promptly - the entire interest charges on the levy stock. Equally so, the government should reimburse interest charges on the free quota stocks also whenever factories are required to carry stocks, too long.

Eximport

There is a better way of putting imported sugar to use. The FCI should stock imported sugar at all important marketing centres and sell it at fixed prices. As the government now feels that price upto Rs.6.50 per kilo of free sugar is tolerable, this imported sugar should be made available @ Rs.625 to Rs.650 per bag, so that the retail price shall be around Rs.7.00 per kg. Thus the FCI gets a better price and there will not be undue demands on imported sugar. The government should be interested in curbing excessive demands.

This system will ensure economic price for local producers, snub excessive demands, prevent skyrocketing of prices and, at the same time FCI shall benefit more.

Thus, the imported sugar shall serve mainly the role of buffer stocks i.e. to maintain prices at reasonable levels without encouraging conspicuous consumption.

Licensing of New Factories

This is one important area where there is much confusion.

Against a target of over 8 million tons of sugar per year, the capacity licensed at the end of the 6th Plan is reported to be only 7.5m.tons. As there will be some lapses, we may expect that the installed capacity shall be only 7.25 million tons. Against this, the installed capacity at the end of 7th Plan is to be 11 million tons i.e. an addition of 3.75 million tons sugar. Presuming that an average new factory produces 20,000 tons sugar, the number of factories to be newly licensed and installed work out to nearly 190 ! As part of this production will be through expansions of existing

factories, one can put down the new factories to be atleast 125 numbers.

By August, 1986, i.e. when nearly 18 months of the 7th Plan are over, not a single licence seems to have been issued. A policy announcement regarding licensing of additional capacity was to have been made by October, 1985, but it hasn't seen the light of the day till August, 1986.

The delay in licensing would definitely create acute scarcity a couple of years later. The delay lengthens the duration of the sugar import era. Perhaps, the imports shall have to be extended upto 1990 atleast.

There is a feeling, amongst administrators and political powers that the country has a built-in capacity to produce about 9 million tons. This is a mis-conception. True, during 1981-82 and 1982-83, production surpassed 8 million tons and some capacity has been added since then. But, the fact is, the high production during those years was achieved by coercing the industry into crushing all available cane, extending the season to lean months of June and July. That cannot be a standard. With the present installed capacity, perhaps only 7.5 million can be produced during the economic period. So, delay in licensing should be expected to create a crisis in the next 2-3 years if not earlier.

Minimum Capacity of Plant

The Ministry of Industry has announced that the minimum capacity of future sugar factories shall be 2000/3000 TCD. The Directorate of Sugar had announced it to be only 1500 TCD. Hence, the disparity is confusing and harmful to industry. At present, there aren't many sites available to support even 1500 TCD plants. Sites capable of supporting a 2000 TCD plant may not be available at all. The capital cost shall be prohibitively high. Co-operatives would not have a chance to come-up, as the farmers may be required to subscribe over Rs. One Crore to promote a factory ! Only multinationals can come in, and only when a site which can feed 3,00,000 tons cane from the first year is available. The government should clarify and fix the minimum capacity at 1500 TCD only.

Sickness in Industry and Development Fund

Thanks to unhelpful policies on the one hand and obsolescent equipment and management techniques on the other, a large section of the industry has gone sick.

To help rehabilitation of sick units, Government of India has floated a Sugar Development Fund. Over the last 4 years or so, Government of India is collecting a special cess of Rs.14 per bag of sugar produced and the amount is set-aside to aid the industry to recoup its health. But red tape prevents the fund being put to use. The money is idle while factories are going

sick. It is illogical to continue to collect the cess over four years when they cannot apply the money for the declared purpose. It is a very deserving case for consumer protection bodies to intervene.

As the difficulties are caused mainly by the stiff attitude of Ministry of Finance, Ministry of Food should atleast stop collecting further cess until methods of disbursing funds are agreed upon. Already over Rs.400 crores must have been collected. The practical way out would be to handover the money to IDBI. Ministries should not be directly involved. There are similar schemes in application in Steel and Shipping Industries. Why not draw upon that experience?

Future Set-up

The present policy of giving priority to co-operatives is likely to continue and rightly so. There should no doubt be a way of ensuring that while elected Directors of Co-operatives, are being given scope to take all decisions, their accountability is not taken seriously now. Boards, which have mismanaged are not brought to book. A few such Boards tarnish the reputation of most societies whose record has been good. Public Sector is obviously most unsuited to run sugar factories. Where co-operative effort is lacking, private sector should be encouraged.

Future

The industry as well as all earlier commissions appointed to report on sugar industry set-up, have recommended a high-power national authority. A National Sugar Authority alone shall be able to administer the industry fairly. Left to political powers and bureaucrats, adhocism shall prevail. The Authority should consist of representatives from sugarcane farmers, industry circles (co-operative and private), Sugar Trade, Sugar Technology Associations, Directors of Sugar Institutes and Cane Research Institutes etc. It is overdue and industry must press for it incessantly.

This national authority should be able to and be entrusted to co-ordinate research and development activities connected with the industry.

At the Jakarta World Congress, 1986, Indian Technologists are presenting a number of papers, but this number is less than that contributed by tiny Taiwan. A lot of home work is required to be done.

A National Authority is a must to oversee all aspects covering Licensing, Production, Pricing, Marketing, Import-Export Buffer Stock, By-Products, Financing, Research, Upgrading, Training etc. and only such a comprehensive set up will put the industry on the path of logical progress and prosperity.

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Sugar Production : 4,66,000 Qtls. (Bags)

Recovery : 11.65

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FINANCING OF CO-OPERATIVE SUGAR FACTORIES - SOME BASIC ISSUES

R. L. Shrivastava
Asst. General Manager, I.F.C.I.

Viability of a Sugar Unit with reference to Installed Capacity

To achieve the production target of 80 lakh mt sugar by the terminal year of the Sixth Five Year Plan, viz., 1985, it was considered, in the year 1981, that about 82 new sugar factories would have to be set up. Accordingly, licensing of additional capacity for establishment of new sugar factories was decided upon with a positive preference towards the cooperative sector and generally in favour of a new sugar unit having an installed capacity of 1250 TCD.

In September 1981, the Working Group appointed by GOI (Department of Agriculture & Cooperation) for financing the new cooperative sugar factories to set up during the Sixth Five Year Plan, placed the cost of a new sugar factory of 1250 TCD at about Rs.750 lakhs. There has been steep rise in the capital cost of a new sugar unit inasmuch as the capital cost of a 1250 TCD sugar unit, which had been placed around Rs.350 lakhs in the year 1973, was subsequently raised to Rs.550 lakhs by the end of 1975. Incidentally, it may be stated that in the year 1975, a sugar unit of 1250 TCD set up at a cost of Rs.450 lakhs was considered to be viable. The Second Inter-Ministerial Group constituted to review/revise the incentive schemes for high cost as well as the expansion projects from the sugar industry, in its Report submitted in May 1980, assessed the cost of a 1250 TCD sugar unit at Rs.650 lakhs. Around the commencement of the Sixth Five Year Plan, as indicated earlier, the cost of setting up a 1250 TCD unit was assessed at Rs.750 lakhs. However, hardly one year after this assessment, the capital cost increased by almost Rs.200 lakhs and the estimated cost of a new sugar unit of 1250 TCD is now placed at Rs.950 lakhs. In a period of 10 years, the cost of setting up of a sugar unit of 1250 TCD has more than doubled.

The continuous upward trend in the capital cost of a 1250 TCD unit has created in its wake several doubts about the viability of such units. It is not only the increasing expenditure on capital inputs which is causing concern, but the progressive erosion of cash

accruals. The change in the debt equity norm from 65:35 to 60:40 has cast a burden upon the grower-members and the state government for raising the necessary resources to the tune of Rs.50 lakhs which they are somehow not prepared to take up themselves and are only too willing to leave the gap (5% of project cost) uncovered. In view of the capital cost showing increasing trend the availability of cash incentives under the Sampath Committee recommendations, on which in-flows of such units are largely dependent, has not only considerably eroded but has also created problems for these mills to get these incentives on account of delay in setting up the unit within the prescribed period of 39 months. To meet the 'gaps' in the project cost, the sugar factories naturally resort to additional borrowings, which not only upset the debt:equity but also add to debt servicing burden. The cyclic fluctuations in the production of sugarcane and sugar have now become a statistical fact and lower realisations on account of this only tend to dry up return flow of funds, resulting in defaults, even in payment of the interest due. In the circumstances, the cash accruals in the projected cash flow statement stand drastically eroded.

It was expressed at the Central Co-ordination Committee for Cooperative Sugar Factories Meeting held in February 1984 that licensing of sugar units in the Seventh Five Year Plan would be in favour of 1500 TCD capacity to ensure operational viability. It is, therefore, absolutely necessary to critically analyse whether the units of 1250 TCD should be installed, even if they have been already licenced since this might involve creation of crushing capacity in the cooperative sector that already has the seeds of incipient sickness sown.

In the light of this background note, it may be necessary to take some hard decisions regarding the setting up of a sugar unit of 1250 TCD in the cooperative sector.

**Sanction of term-loans by the
All-India Term Lending Institutions
on the basis of normative cost instead of actual cost**
On account of the ever increasing capital

outlay on setting up of new sugar units of 1250 TCD, the All-India Term Lending Institutions had, in August 1982, adopted the normative cost approach for grant of institutional finance. Although the actual cost of a 1250 TCD sugar unit was being appraised by All-India Term lending Institutions themselves, at Rs.950 lakhs, for the purpose of financing, the normative cost of such a unit was pegged at Rs.900 lakhs.

The rationale behind the adoption of this approach is stated to be the study conducted by the IFCI, the lead term lending institution for the Sugar Industry. According to this Study, the project cost of a new sugar unit of 1250 TCD was assumed at Rs.850 lakhs any cost above this level would have to be subjected to careful scrutiny with reference to certain parameters, upto Rs.900 lakhs. The gap, beyond Rs.900 lakhs, if any, is necessarily required to be financed by the sugar unit concerned from out of own or borrowed resources. The finding of own resources by the sugar factories to bridge the gap is out of question since the grower-members find it difficult to even raise their 10% share capital contribution. The State Government due to financial constraints find it difficult to meet even the committed portion of their share capital contribution and as far as possible evade the question of financing the gap between the normative cost and actual cost. Out of the debt component (Rs.540 lakhs) of the normative cost (Rs.900 lakhs) for the setting up of a sugar unit of 1250 TCD, the term lending institutions generally allocate Rs.100 lakhs to be financed by commercial/cooperative banks.

As most of the sugar factories licenced in the Sixth Five Year Plan are to be set up in the cooperative sector, the sugar factories, as and when the term loans are sanctioned by term lending institutions, approach the concerned State/Central Cooperative Banks to provide the share of Rs.100 lakhs earmarked by the term lending institutions. It may be recalled that in order to relieve, to some extent, the constraint on the resources of the term lending institutions, it was agreed, in a joint meeting of the representatives of Financial Institutions, Government of India and Commercial/Cooperative Banks, held in September 1981, that Reserve Bank of India would permit cooperative/commercial banks to participate in the consortium with term lending institutions in financing new sugar factories. The term lending institutions, however, have been allocating Rs.100 lakhs to be raised from the cooperative/commercial banks irrespective of the resources position of the concerned banks.

Besides this, the uncovered gap between normative cost and the actual cost, which the term lending institutions insist should be brought in by the grower-members/state government, generally also falls to the lot of the concerned cooperative banks, since the sugar factory as well as the State Government

obviously took the cooperative banks to make good the shortfall. Therefore, the amount to be raised from the banking sector is higher than the Rs.100 lakhs allocated by the term lending Institutions. NABARD has, time and again, stated that the cooperative banks do not have long term surplus resources since their funds are involved to a substantial extent in financing distribution of fertilisers, working capital requirements of cooperative/processing units, marketing activities and public distribution system, besides the obligatory financing of agricultural operations. They are, therefore, not in a position to participate in the provision of block capital loans to the new sugar factories. Although NABARD is aware that term lending institutions do not direct the sugar factories to obtain the amount of Rs.100 lakhs, etc., from the cooperative banks, the sugar factories and the State Government as well, consider it their right to approach the cooperative banks since the processing-manufacturing activity is being installed in the cooperative sector. The reluctance of NABARD in granting authorisation to cooperative banks has to be viewed in this context, particularly non-availability of term resources, leaving the borrowing unit not only in a difficult and embarrassing situation but also upsetting the time-schedule for implementation, with the resultant cost overruns, etc.

The concept of the normative cost being adopted for financing the block capital requirements of a sugar unit has been taken up by NABARD at several forums. It has been emphasising time and again that the All-India Term lending Institutions should work out financing arrangements for meeting the entire project cost of a sugar unit without leaving any uncovered gap.

Government of India, Ministry of Agriculture, Government of Uttar Pradesh and the National Federation of Cooperative Sugar Factories had also taken up this matter. The plea of the All-India Term Lending Institutions has been that due to the substantially increased anticipated demand for institutional finance for setting up new sugar factories, in comparison to earlier assumptions, particularly in regard to the requirements of funds from other priority sectors, vis-a-vis the sugar industry, a certain degree of rationing of resources is necessary and that is why the normative cost concept is adopted. The resources constraint and competing demands would, of course, not enable the All-India Term lending Institutions to meet the entire requirements of funds of all the new sugar factories. Instead of rationing out the available resources to a larger number of sugar factories and meeting only a part of their requirements, it is desirable that the All-India Term lending Institutions consider financing, in a phased manner, if necessary, those sugar factories whose entire term finance can be met on the basis of actual project outlay. Realistic

estimates could be worked out on the basis of spot appraisals too.

Incidentally, in Maharashtra, it is particularly observed that project costs are placed at Rs.1000/1050 lakhs, in which case the gap is Rs.100/150 lakhs besides the amount of Rs.100 lakhs earmarked for the cooperative/commercial banks. As Maharashtra accounts for the largest number of sugar factories being set up in the cooperative sector, the bridging of this gap becomes well nigh impossible. The State Government is not inclined to contribute any additional funds to bridge the gap between the normative and actual costs and expects the Maharashtra SCB to grant the term loan to meet this shortfall. It may be stated that provision of block capital loans to new cooperative sugar factories is an area of least priority to the cooperative banking sector.

Keeping in view the above observations, it would be in the interest of the Cooperative Sugar Industry if the All-India Term Lending Institutions :

- (a) consider financing, if necessary, in a phased manner, only such number of sugar factories as could be provided with their entire block capital financial requirements;
- (b) ensure that the entire financial arrangements are made to their satisfaction; and
- (c) evolve a proper consultative process to identify the bank(s) who could participate with them in providing the term loans.

Diversification Programme of Cooperative Sugar Factories

The Sugar Industry is agro-based and seasonal in nature. In the cooperative sector, the sugar factories are not only dependent upon the vagaries of the seasons for supply of cane but also upon several other extraneous factors which affect their working. The All-India Term lending Institutions have been advocating the desirability of the cooperative sugar factories diversifying into areas using the Industry's by-products, such as, molasses and bagasse. It is reported that the setting up of the by-product industries has now become possible after the announcement of the Sugar Development Fund Rules by Government of India. The main reason for the diversification programme is that several cooperative sugar factories can definitely improve their viability.

The cooperative sugar factories generally approach the cooperative banking sector to sanction term-loans for the setting up of distilleries or Acetone plants with molasses as feed-stock and paper plants with bagasse as feed-stock.

The plea in respect of distilleries/acetone plants is that the All-India Term Lending Institutions do not grant term-loans for such purposes since these

enjoy a low priority on the list of industries eligible for grant of term finance.

Regarding the bagasse based paper plants, it has been given to understand that IDBI has undertaken a study of the viability of such units and, only thereafter, would it be possible to decide whether term lending institutions will be inclined to grant term loans for this purpose or not. The outcome of the study has not so far been made known to NABARD.

The term lending institutions are stated to be in favour of diversification by the sugar factories as a means of improving their viability. Those programmes envisaging use of by-products considered to be viable and which will generate enough cash not only to meet the obligations under the diversification but also the term loans raised for setting up the sugar factory, should be considered by the All-India Term Lending Institutions for grant of term finance. At the joint meeting held in Reserve Bank of India, it was indicated that both expansion and diversification programmes of sugar factories would be given priority for sanction of term loans by the All-India Term lending Institutions. This could be made known to the cooperative sugar factories for necessary action. NABARD would have no objection in granting authorisation to cooperative banks to provide the working capital requirements of cooperative sugar factories, including distilleries, Acetone/paper etc., plants set up by them.

Timely Identification of sickness in the Sugar Industry

Owing to a variety of reasons, such as delays in the setting up of the units, management inefficiency, financial indiscipline, payment of high cane prices, non-utilisation of installed capacity, inadequacy of cane, lower realisations from sugar sales, lack of cost consciousness, obsolescence of plants, etc., have left many a cooperative sugar unit sick or showing signs of incipient sickness. Several units have been working at losses for a number of years and have almost wiped out their owned funds. Once a unit slips beyond a certain point in its financial position, it becomes irretrievable. In order to prevent units reaching the point of no return, timely action to identify the problems of those showing signs of incipient sickness would help in rehabilitating them. In this context, it may be considered whether it is worthwhile to set up a watch dog body which could constantly oversee the working of the units in the Sugar Industry so as to suggest timely and appropriate rehabilitation programme(s).

★★★

Shri Dnyaneshwar Sahakari Sakhar Karkhana Ltd.

Dnyaneshwarnagar

P.O. Bhende Sakhar Karkhana 414 605

Tal : Newasa, Dist : Ahmednagar

Maharashtra State

Grams : DNYANESHWAR, Newasa Tel : 49 Newasa Ex.

**Ours is a Co-operative Sugar Factory established in 1974
with a crushing capacity of 1250 TCD and has
successfully completed 12th Crushing Season
with an expanded capacity of 2000 TCD.**

A Distillery Project of 90 Lakhs Litres per annum is in progress

**Our Cooperative comprises about 90% of share-holders
having only one or two acres of cane and
we are aiming at the
prosperity of Producer Members, Workers and Consumers
by providing various facilities such as
Education, Lift Irrigation, Medical Assistance etc.**

**R. M. JAGDHANE
Managing Director**

**B. D. Patare
Vice-Chairman**

**M. S. PATIL
Chairman**



MARKETING AND STORAGE OF SUGAR IN INDIA

DR. G. J. KHUDANPUR

1. Introduction

Before 1932 AD when the Indian Sugar Industry began to establish itself firmly under tariff protection, there was no sugar industry in India worth mentioning. The country relied on import to meet its domestic demand for sugar. However, by 1936-37 when World War II broke out, India had become self-sufficient in sugar. From then onwards the industry grew steadily and production kept pace with consumption and if anything there was marginal surplus. After 1957, India entered the export market, but in a very small way. However, in 1975-76, it was able to export a little over one million tonnes. Under the International Sugar Agreement, which has since expired, India had been allotted an export quota of 8.25 lakh tonnes per annum. However, India has so far been unable to maintain exports at that level. On the contrary in the recent past, it has been obliged to resort to massive imports of sugar. The Industry claims that this is the outcome of erroneous government policies which stimulate demand through pegging of price at a low level and at the same time depress production of sugar. Consequently, there is need to examine the government policies in relation to supply, demand and price of sugar.

2. Supply of Sugar

It may be seen from the data presented in Table 1 that the production of sugar has increased from 42.62 lakh tonnes in 1975-76 to 61.44 lakh tonnes in 1984-85, a rise of nearly 50% over a period of ten years. But what is more significant is that in two consecutive years viz. 1981-82 and 1982-83 the production of sugar was in excess of 82 lakh tonnes, indicating the vast potential of the Indian Sugar Industry. The sugar industry is capable of growth and will deliver the goods provided suitable policies are pursued by the Government.

3. Sugar Production

There were in 1984-85, 338 sugar mills in opera-

tion and they produced in all 61.44 lakh tonnes of sugar. The sugar that is produced is graded with reference to the size of the granules and the colour. There are 5 grades of size (viz. A, B, C, D, E) and two grades of colour (viz. 30 and 29). Thus, in all ten qualities of sugar are produced in India. The data regarding percentage-wise distribution of sugar production by these 10 quality grades has been presented in Table 2. It may be noted that nearly 99.5% of total production is graded and given ISS numbers. The ten-year data for the period 1975-76 to 1984-85 indicates that the most important grade of sugar provided is D-30, which accounts for nearly 50% of the production. The next most important grade of sugar produced in India is C-30, which accounts for nearly one-third of total production of sugar. The grade E-30 accounts for a little over 10% of total production. Thus, D-30, C-30 and E-30 grades of sugar together account for more than 90% of all the sugar produced in the country.

4. Performance of Sugar Industry

In each Five Year Plan a target of production is prescribed for all important industries. The sugar industry has consistently exceeded the target of production prescribed for it in each one of the Five Year Plans. Also, sugar industry has an excellent record of capacity utilisation. In fact the capacity utilisation rate is higher than 100% in the case of a large number of the sugar mills, particularly in the tropical belt. Consequently, one wonders why there is shortage of sugar and need for imports. This is because the estimates of demand have fallen far short of the actual demand. The reason for this is the erroneous price policy followed by the government - a policy which not only encourages consumption but also depresses production at the same time.

5. Consumption of Sugar

In Table 3, we have presented data on annual per capita consumption of sugar, gur and khandsari

Table 1
Statement showing Factories in Operation, Opening Stocks, Production, Imports,
Consumption & Exports of Sugar during the last 10 Years (In lakh tonnes)

Season	No. of Factories in operation	Carry over in the beginning of the season	Production during the year	Imports	Total available supply	Consump- tion	Exports
1975-76	252	12.83	42.62	-	55.45	36.89	10.21
1976-77	270	8.35	48.40	-	56.75	37.57	3.12
1977-78	287	16.06	64.61	-	80.67	44.82	2.02
1978-79	298	33.83	58.41	-	92.24	62.14	8.63
1979-80	300	21.47	38.58	1.80	61.85	52.08¶	2.90
1980-81	315	6.87	51.48	2.15	60.50	49.80¶	0.61
1981-82	320	10.09	84.37	-	94.46	57.11¶	3.83
1982-83	320	33.52	82.29	-	115.81	64.79	4.22
1983-84*	325	46.80	59.17	0.64	106.61	75.70	7.06
1984-85*	338	23.85	61.44	12.89	98.18	69.61§	0.38

* Provisional

§ Excluding imported sugar

¶ Figures include consumption of imported sugar

Table 2
Percentage of Quality-wise Production of Sugar

I. S. S. No.	75-76	76-77	77-78	78-79	79-80	80-81	81-82	82-83	83-84		84-85
A 30	0.74	0.62	0.48	0.52	0.60	0.31	0.18	0.12	0.10	L-30	4.05
B 30	3.22	4.11	3.76	4.07	4.56	3.50	2.90	3.72	4.19	M-30	32.35
C 30	29.98	26.44	22.79	29.43	29.69	26.71	23.80	26.02	32.00	S-30	61.17
D 30	45.78	47.10	44.79	46.95	44.26	51.01	50.22	51.53	47.26		
E 30	13.88	17.91	17.04	13.59	14.58	15.63	18.12	15.30	12.70		
Total	93.60	96.18	88.86	94.56	93.69	97.16	95.22	96.69	96.25		97.57
A 29	0.02	0.02	0.01	0.04	0.13	0.01	0.03	-	-	L-29	0.06
B 29	0.16	0.12	0.50	0.47	0.30	0.16	0.17	0.30	0.24	M-29	1.05
C 29	1.52	1.01	2.86	2.14	2.23	0.67	1.27	1.09	0.99	S-29	0.78
D 29	3.56	1.65	4.68	1.86	2.28	1.18	1.93	1.13	1.19		
E 29	0.72	0.59	2.69	0.47	0.75	0.32	0.98	0.35	0.42		
Total	5.98	3.39	10.74	4.98	5.69	2.34	4.38	2.87	2.84		1.89
Ungraded	0.42	0.43	0.40	0.46	0.62	0.50	0.40	0.44	0.91		0.54

Source : National Sugar Institute, Kanpur

in India, for the years 1960-61 to 1983-84. From the data it is clear that while the consumption of all sweetening agents together has gone up from 20 kgs per capita per annum to 24.2 kgs per capita per annum over a period of 24 years, that of sugar has gone up from 4.8 kgs to 10.5 kgs. Thus there is a marked shift in consumer preference for sugar over other sweetening agents, such as gur and khandsari, whose consumption per capita has actually started declining. It may further be noted that the overall per capita consumption of sweetening agents in India is substantially below that of developed industrial nations where the per capita consumption of sugar is in excess of 100 kgs. Consequently one may expect a steady rise in demand for sugar in India in the future, both due to increase in population and improvement in per capita income. The price policy pursued by the government also encourages consumption. The imbalance between supply and demand which leads to years of glut when prices are depressed also stimulate consumption. For example, in 1978-79 because of a glut in the sugar market the consumption of sugar shot upto 62.14 lakh tonnes from the level of 44.82 lakh tonnes consumed in the previous year. A similar jump in consumption was recorded in the year 1983-84 when a record volume of 75.70 lakh tonnes of sugar was consumed. From the foregoing analysis it is clear that whenever the prices dip and sugar becomes available, consumption shoots up, indicating that the consumption has been held in restraint.

6. Equilibrium between supply of and demand for Sugar

The main problem in the marketing of sugar in India is that of matching supply to the demand. This is not easy. For, even when annual supply and demand are in equilibrium, there is the problem of matching supply and demand. This is because production is seasonal and levels of consumption fluctuate. Consequently, there is need to store the sugar so that it may be made available whenever needed.

7. Imbalance between Production & Consumption

In Table 4 we have presented data on annual production and consumption of sugar for the years 1960-61 to 1985-86. It may be seen that during these 26 years, in 9 years there was deficit and in 17 years there was surplus production. The surplus ranged from 1.67% to 44.75% of the production during the year. The deficit ranged from 6% to 24.47%. Thus it is seen that while the surpluses were large the deficits were relatively moderate. Also the years of deficit

were preceded by years of surplus. Hence there was no stress on consumption in years of deficit as there were carry over stocks from the previous years to make up the deficit. It may further be noted that in the sixties, one year in each quinquennium was a deficit year. In the seventies, it is seen that two years in each quinquennium were deficit years. In the eighties, the situation has turned for the worse and for the first time, there has been deficit in three consecutive years.

8. Carry-over Stocks

The data on carry-over stocks for the years 1960-61 to 1985-86 have been presented in Table 5. From the data, it is seen that for the entire period of 26 years the average carry-over stock was approximately 33.9% of the production during the year. The distribution of the carry-over stock showed that in 13 years it was under 23.84% and in the remaining 13 years, it was above 33.28%. In fact there were seven years in which the carry-over stock was in excess of 50%. The highest carry over stock on record was during the year 1983-84, when it was equal to 79.09% of the production during the year.

9. Quinquennial Analysis

The annual data on carry-over stock presented in Table 5 has been presented on a quinquennial basis in Table 6 for the 22 years from 1960-61 to 1981-82. The 20-year period from 1960-61 to 1979-80 has been divided into 4 quinquenniums beginning with the sugar-cane crushing seasons 1960-61, 1965-66, 1970-71 and 1975-76. The annaulaverages for these 4 quinquenniums have also been compared with the annual averages for the biennial period covering the years 1980-81 and 1981-82. From the data presented in Table 6, it is apparent that on an average the carry over stocks in each quinquennium varied from 26.56 lakh tonnes to 36.48 lakh tonnes. The range of variation is thus approximately one million tonnes only. Thus it may be seen that the variation in annual carry-over stock is much larger and exerts a depressing influence on the market. This is not so apparent from the quinquennial data.

10. Similarly, data presented in Table 4 on annual production, consumption and surplus or deficit have been presented on a quinquennium basis for the 22 year period from 1960-61 to 1981-82 in Table 7. From the data, it is clear that production and consumption are fairly balanced and if anything there is marginal surplus production. The order of surplus has increased significantly in the eighties, indicating a need to export the surplus. However, in practice, three consecutive

years of deficit have wiped out the surplus and to maintain a minimum level of stocks massive imports had to be resorted to.

11. Carry-over Stocks

As we have seen from Table 7, the country produces more sugar than is needed for domestic consumption. Hence, some stocks will have to be

carried over. However, the quantum of surplus is not very large and may be utilised for export to meet the export commitments made under bilateral trade agreements. The real need for stock arises because of the seasonal character of sugar production and balanced consumption throughout the year.

12. Effect of Seasonal Production of Sugar

Sugar Industry is a seasonal industry. The bulk

Table 3
Per Capita Consumption of Sugar, Gur & Khandsari

Year	Population in million (as on 1st March)	Consumption (Lakh tonnes)		Per Capita Consumption (kgs. per annum)		Total per capita consumption of Sugar, Gur & Khandsari (kg. per annum)
		Sugar	Gur & Khandsari*	Sugar	Gur & Khandsari*	
1960-61	439	21.13	66.87	4.8	15.2	20.0
1961-62	448	25.88	64.32	5.8	14.4	20.2
1962-63	458	24.86	60.74	5.4	13.3	18.7
1963-64	468	23.07	66.67	4.9	14.2	19.1
1964-65	478	24.69	72.05	5.2	15.1	20.3
1965-66	489	28.10	69.11	5.7	14.1	19.8
1966-67	500	26.01	61.25	5.2	12.2	17.4
1967-68	511	22.15	63.05	4.3	12.3	16.6
1968-69	523	26.05	73.46	5.0	14.0	19.0
1969-70	534	32.64	74.01	6.1	13.9	20.0
1970-71	546	40.25	74.37	7.4	13.6	21.0
1971-72	558	37.95	69.98	6.8	12.5	19.3
1972-73	570	35.14	70.30	6.2	12.3	18.5
1973-74	581	35.18	83.36	6.1	14.3	20.4
1974-75	593	34.76	80.63	5.9	13.6	19.5
1975-76	609	36.89	83.67	6.1	13.7	19.8
1976-77	621	37.57	88.41	6.1	14.2	20.3
1977-78	633	44.82	90.88	7.1	14.4	21.5
1978-79	646	62.14	75.96	9.6	11.8	21.4
1979-80	669	52.08¶	75.48	7.8	11.3	19.1
1980-81	684	49.80¶	86.33	7.3	12.6	19.9
1981-82	700	57.11¶	80.40	8.2	11.5	19.7
1982-83**	710	64.79	86.65	9.1	12.2	21.3
1983-84**	723	75.70	99.32	10.5	13.7	24.2

* Entire annual production of gur and khandsari is taken as consumed internally

** Provisional

¶ Includes consumption of imported sugar

of the production takes place during December, January, February and March. This can be seen from data regarding monthly production of sugar in India presented in Table 8. Similarly, the data regarding monthly releases and despatches is presented in Table 9. The data on production and releases have been presented as percentages of production, cumulated and the resultant surplus or deficit have again been presented as % of production, in Table 10. The next Table viz. Table 10 shows the actual level of month-end stores, month-wise for the years 1973-74 to 1982-83.

13. Production & Consumption Patterns

The sugar is produced mainly during the months

of December, January, February and March. Nearly three-fourths of all production is produced during these four months. June to October are the lean months, and together account for less than 4% of national production. On the other hand consumption is steady throughout the year and the monthly fluctuations therein are small and insignificant. Nonetheless it may be observed that during the festival season i.e. September, October, November the consumption is somewhat higher. Anyway to bring about adjustment between production and consumption, stocks will have to be carried over. In fact the stocks will be highest in the month of April, 1960. In fact, during the summer months of March, April and May, the

Table 4
Data on annual domestic production and consumption of Sugar in India during the period 1960-61 to 1985-86

Season	Production during the year (lakh tonnes)	Consumption during the year (lakh tonnes)	Surplus(+) or deficit(-) (lakh tonnes)	Surplus or deficit as % of consumption (%)
1960-61	30.21	20.87	9.34 (+)	44.75
1961-62	27.29	26.01	1.28 (+)	4.92
1962-63	21.39	25.02	3.63 (-)	14.51
1963-64	25.73	23.26	2.47 (+)	10.62
1964-65	32.32	24.37	7.95 (+)	32.62
1965-66	35.41	27.92	7.49 (+)	26.83
1966-67	21.51	25.95	4.44 (-)	17.11
1967-68	22.48	22.11	0.37 (+)	1.67
1968-69	35.59	26.09	9.50 (+)	36.01
1969-70	42.62	32.61	10.01 (+)	30.70
1970-71	37.40	40.25	2.85 (-)	7.80
1971-72	31.13	37.95	6.82 (-)	17.97
1972-73	38.73	35.14	3.59 (+)	10.22
1973-74	39.48	35.22	4.26 (+)	12.10
1974-75	47.97	34.35	13.62 (+)	39.65
1975-76	42.62	36.89	5.73 (+)	15.53
1976-77	48.40	37.57	10.83 (+)	28.83
1977-78	64.61	44.82	19.79 (+)	44.15
1978-79	58.41	62.14	3.73 (-)	6.00
1979-80	38.58	51.08	12.50 (-)	24.47
1980-81	51.48	49.02	2.46 (+)	5.02
1981-82	84.35	60.00	24.35 (+)	40.58
1982-83	82.29	64.79	17.50 (+)	27.01
1983-84	59.17	75.46	16.29 (-)	21.59
1984-85	61.44	70.50	9.06 (-)	12.85
1985-86	70.00	82.00	12.00 (-)	14.63

Table 5
Data on carry over Sugar Stock at the beginning of the Crushing Season for the Years 1960-61 to 1985-86

Season	Carry over stock at the beginning of the season (lakh tonnes)	Production during the year (lakh tonnes)	Carry over stock as percentage of production during the year (%)
1960-61	7.42	30.21	24.56
1961-62	14.82	27.29	54.31
1962-63	12.56	21.39	58.72
1963-64	3.27	25.73	12.71
1964-65	3.31	32.32	10.24
1965-66	8.59	35.41	24.26
1966-67	12.16	21.51	56.53
1967-68	5.37	22.48	23.89
1968-69	4.35	35.59	12.22
1969-70	13.06	42.62	30.64
1970-71	20.90	37.40	55.88
1971-72	14.10	31.13	45.29
1972-73	5.84	38.73	15.08
1973-74	8.46	39.48	21.43
1974-75	8.57	47.97	17.87
1975-76	12.95	42.62	30.38
1976-77	8.47	48.40	17.50
1977-78	16.18	64.61	25.04
1978-79	33.33	58.41	57.06
1979-80	21.24	38.58	55.05
1980-81	8.25	51.48	16.03
1981-82	12.25	84.35	14.52
1982-83	33.00	82.29	40.00
1983-84	46.80	55.17	79.09
1984-85	23.85	61.44	38.82
1985-86	28.19	70.00	40.27

stock level is consistently high, and is invariably above 30% of production. Thus it may be noted that the seasonal character of production by itself generates

carry-over stocks.

14. Policy of Release of Sugar

Of the total sugar manufactured in the country bulk portion is acquired by the government at source as levy sugar at a price fixed by the government. Till

Table 6
Quinquennial Data on Carry over Sugar Stock at the beginning of the crushing season for the period 1960-61 to 1981-82

Quinquennium beginning with the season	Quinquennial Average of carry over stock (lakh tonnes)	Quinquennial Average of carry over annual production of sugar (lakh tonnes)	Average carry over stock as percentage of average production (%)
1960-61	8.28	27.39	30.23
1965-66	8.71	31.52	27.63
1970-71	11.57	38.94	29.71
1975-76	18.43	50.52	36.48
1980-81*	17.83	67.91	26.56

* Average for the two years 1980-81 & 1981-82

Table 7
Data on quinquennial average annual production and consumption of Sugar in India during the period 1960-61 to 1981-82

For the Quinquennium beginning from the season	Average annual production of sugar (lakh tonnes)	Average annual consumption of sugar (lakh tonnes)	Annual surplus or deficit (lakh tonnes)	Surplus or deficit as % of annual consumption (%)
1960-61	27.39	23.91	3.48(+)	14.55
1965-66	31.52	26.94	4.58(+)	17.00
1970-71	38.94	36.58	2.36(+)	6.45
1975-76	50.52	46.50	4.02(+)	8.65
1980-81*	67.92	54.51	13.41(+)	24.60

* Average of the two years 1980-81 & 1981-82

Table 8
Monthly Production of Sugar in India

	76-77	77-78	78-79	79-80	80-81	81-82	82-83	83-84	84-85	85-86*
October	0.78	0.33	0.74	0.22	0.21	0.56	1.01	0.25	0.18	0.41
November	4.26	2.52	3.21	2.70	4.15	5.64	5.06	2.82	4.41	5.88
December	8.98	9.04	8.92	7.67	9.65	11.73	11.96	10.78	11.40	13.29
January	10.51	11.47	11.25	9.80	12.16	14.10	14.72	13.90	13.86	14.90
February	9.33	10.46	10.70	8.67	10.73	13.54	14.31	12.82	12.67	13.55
March	7.94	11.38	11.03	6.14	8.68	14.03	14.82	10.52	10.93	11.58
April	4.38	9.37	7.55	2.40	4.05	11.57	11.96	5.43	5.15	5.96
May	1.24	6.02	3.57	0.45	0.78	8.18	6.49	1.72	1.28	2.00
June	0.11	2.44	0.84	0.08	0.08	3.24	1.49	0.25	0.42	
July	0.19	0.93	0.21	0.17	0.19	0.91	0.25	0.16	0.38	
August	0.30	0.31	0.20	0.15	0.36	0.42	0.04	0.12	0.37	
September	0.38	0.34	0.19	0.13	0.44	0.46	0.21	0.17	0.40	
Total	48.40	64.61	58.41	38.58	51.48	84.38	82.33	58.94	61.45	67.60¶

* Provisional

¶ Upto May 1986

Table 9
Month-wise Releases and Despatches of Levy & Free Sugar

(in lakh tonnes)

	Levy Sugar		Free Sugar §		Total Sugar		Exports	Total Despatches
	Release	Despatch*	Release	Despatch*	Release	Despatch*	(Offtake)	(including Export)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(6 + 7)
1982-83								
October	3.44	3.11	3.20	3.11	6.64	6.22	0.28	6.50
November	2.94	3.22	3.20	2.97	6.14	6.19	0.25	6.44
December	2.94	2.88	3.00	2.77	5.94	5.65	0.57	6.22
January	2.94	2.26	2.50	2.45	5.44	4.71	0.14	4.85
February	2.94	2.62	2.00	1.88	4.94	4.50	0.04	4.54
March	2.94	3.55	1.50	1.42	4.44	4.97	0.02	4.99
April	2.94	3.21	1.50	1.50	4.44	4.71	-	4.71
May	2.94	3.06	1.70	1.55	4.64	4.61	0.08	4.69
June	2.94	3.07	2.30	2.27	5.24	5.34	0.59	5.93
July	2.94	3.06	2.60	2.46	5.54	5.52	0.26	5.78
August	2.94	3.12	2.80	2.82	5.74	5.94	0.81	6.75
September	2.94	3.12	3.20	3.13	6.14	6.25	1.25	7.50
Total	35.78	36.28	29.50	28.33	65.28	64.61	4.29	68.90
1983-84								
October	3.63	3.47	3.30	3.58	6.93	7.05	1.25	8.30
November	3.13	2.98	3.30	2.85	6.43	5.83	1.80	7.63
December	3.13	3.50	3.00	2.72	6.13	6.22	1.09	7.31
January	3.13	2.50	3.25	3.44	6.38	5.94	0.28	6.22
February	3.13	2.65	3.25	2.88	6.38	5.53	0.74	6.27
March	3.13	3.30	3.55	3.21	6.68	6.51	0.19	6.70
April	3.13	2.71	3.35	3.07	6.48	5.78	0.37	6.15
May	3.13	2.84	3.10	2.78	6.23	5.62	0.40	6.02
June	3.13	3.19	3.40	3.04	6.53	6.23	0.17	6.40
July	3.13	3.20	3.40	3.28	6.53	6.48	0.18	6.66
August	3.13	3.40	3.40	3.22	6.53	6.62	0.10	6.72
September	3.63	3.20	3.70	3.41	7.33	6.61	0.02	6.63
Total	38.56	36.94	40.00	37.48	78.56	74.42	6.59	81.01
1984-85								
October	3.13	2.72	3.85	3.54	6.98	6.26	-	6.26
November	3.13	1.93	3.85	3.59	6.98	5.52	-	5.52
December	3.13	1.70	4.35	4.01	7.48	5.71	0.01	5.72
January	3.13	2.06	3.90	3.55	7.03	5.61	0.01	5.62
February	3.13	2.35	3.80	3.23	6.93	5.58	-	5.58
March	3.13	2.73	3.80	3.53	6.93	6.26	0.03	6.29
April	3.13	2.50	3.70	3.35	6.83	5.85	0.01	5.86
May	3.13	3.05	3.60	3.44	6.73	6.49	0.11	6.60
June	3.63	4.04	3.75¶	2.42§	7.38	N A	0.01	N A
July	3.13	3.62	3.75¶¶	2.00§	6.88	N A	0.03	N A
August	3.63	3.25	4.00¶¶	2.13§	7.63	N A	0.04	N A
September	3.63	2.72	4.00¶¶	2.15§	7.63	N A	0.13	N A
1985-86								
October	3.63	2.75§	4.00¶¶	2.13§	7.63	N A	-	N A
November	3.63	2.48§	4.00¶¶	2.09§	7.63	N A	0.01	N A
December	3.13	2.13§	3.75¶	2.40§	6.88	N A	-	N A
January	3.13	2.35§	3.75¶	2.35§	6.88	N A	0.02	N A
February	3.13	1.85§	3.60	2.33§	6.73	N A	0.01	N A
March	3.13	2.94§	3.50	2.22§	6.63	N A	0.01	N A
April	3.13	2.95§	4.00	2.70§	7.13	N A	0.01	N A
May	3.13	2.99§	4.50	3.53§	7.63	N A	0.10	N A
June	3.13	N A	4.50	N A	7.63	N A	N A	N A
July	3.13	N A	4.50	N A	7.63	N A	N A	N A

Note : Some quantity of imported sugar is released in levy during 1984-85 & 1985-86. Break-up of imported and indigeneous sugar is not available.

* Provisional

¶ Includes 1.25 lakh tonnes imported sugar

¶¶ includes 1.75 lakh tonnes imported sugar

§ Excluding Imported Sugar

Table 10

Monthwise Production, Releases and Cumulative Surplus or Deficit
as Percentage of Production

Month	Month-wise Releases of Sugar as Percentage of Annual Release during				Monthly Produc- tion of Sugar as % of annual Produc- tion	Cumulative % of		Cumulative Surplus (+) or Deficit (-) as % of Production
	82-83	83-84	84-85	Tri- nnial Average		Produc- tion	Consump- tion	
October	10.17	8.62	8.18	8.99	0.78	0.78	8.99	8.21 (-)
November	9.40	8.28	8.18	8.62	6.34	7.12	17.61	10.49 (-)
December	9.10	7.80	8.74	8.55	16.42	23.54	26.16	2.62 (-)
January	8.33	8.12	8.23	8.23	20.40	43.94	34.39	9.55 (+)
February	7.57	8.12	8.12	7.94	18.80	62.74	42.33	20.41 (+)
March	6.80	8.50	8.12	7.81	17.40	80.14	50.14	30.00 (+)
April	6.80	8.25	8.00	7.68	11.28	91.42	57.82	33.60 (+)
May	7.11	7.93	7.88	7.64	5.42	96.84	65.46	31.38 (+)
June	8.03	8.32	8.65	8.33	1.63	98.47	73.79	24.68 (+)
July	8.49	8.32	8.04	8.28	0.62	99.09	82.07	17.02 (+)
August	8.79	8.32	8.93	8.68	0.41	99.50	90.75	8.75 (+)
September	9.41	9.42	8.93	9.25	0.50	100.00	100.00	0.00
Total	100.00	100.00	100.00	100.00	100.00			

Table 11

Month End Stocks of Sugar with Factories

(In '000 tonnes)

	73-74	74-75	75-76	76-77	77-78	78-79	79-80	80-81	81-82	82-83
October	554	545	829	589	1232	2720	1430	277	413	2710
November	503	587	680	691	1126	2490	1116	424	676	2573
December	841	999	1085	1203	1657	2706	1496	971	1408	3137
January	1275	1604	1601	1864	2405	3303	2149	1766	2392	4110
February	1682	2137	2073	2466	3107	3728	2628	2449	3275	5078
March	2042	2638	2357	2895	3888	4238	2756	2902	4183	6047
April	2141	2866	2398	2988	4466	4529	2574	2908	4883	6773
May	2002	2805	2138	2801	4690	4351	2007	2520	5246	6964
June	1753	2526	1832	2499	4538	3911	1574	2091	5049	6541
July	1452	2089	1502	2191	4167	3290	1232	1650	4528	5984
August	1124	1602	1186	1878	3822	2722	910	1205	3875	5315
September	828	1207	832	1575	3289	2085	597	777	3263	4587

recently the levy price used to be below the cost of production of sugar. Consequently, the factories had to sell their free-sale quota at a higher price to break even. Sometimes the price realised on free-sale sugar was not large enough to cover the cost of production and factories had to go in the red. It may be noted that the levy sugar constituted from 55% to 65% of production and the percentage was announced each year by the government. The levy sugar was used primarily to support the public distribution system and the surplus if any was utilised either for export or to build up buffer stocks. The factories were not really free to dispose off their free-sale quota at will. In fact, the government regulated the supply of sugar even in the free market by announcing what quantity of the free-sale quota can be released each month. Thus the monthly releases of levy and free-sale quota determined the availability of sugar in the free market and to the public system. Formerly the monthly releases were based on actual consumption during the respective months. The release mechanism was used primarily to regulate prices in the free market. Whenever the price rose, the release

quota was increased to bring the price down. However, the release policy has not worked too well in the past and has come in for severe criticism. In fact alternative suggestions have been made as to how the release mechanism should function. In fact, Shri M. Anand, a distinguished Sugar Technologist, has suggested that 7.5% of production should be released every month during the months of December, January, February and March, 8.5% of production should be released each month during the months of April, May, June and July, and 9% of production should be released each month during the months of August, September, October and November. This recommendation takes into account seasonal fluctuations in demand for sugar and in the availability of alternative sweetening agents like gur and khandsari. In addition, there is need to maintain (i) an emergency stock equivalent to 1.25% of national production, (ii) a buffer stock of 6.25% to be built up from free-sale quota and (iii) a buffer stock of 6.25% to assure supplies for export. Thus it is clear that the overall carry over stock will have one component to match seasonality in production

Table 12
Comparative Figures of Statewise Allocation of Levy Sugar
under Consumption Pattern & Population Basis

States	Monthly allocation of sugar based on consumption pattern made by Govt. till November, 1977 which was based on past consumption patter	Projected monthly allocation of sugar based on consumption pattern taking into account the present overall allocation of 3.13 lakh tonnes/month (Figures in 000 tonnes)	Current monthly allocation of sugar based on population
Andhra Pradesh	15.9	21.8	24.0
Assam	5.8	7.9	9.2
Bihar	20.4	27.9	31.6
Delhi	6.0	8.2	6.8
Gujarat	15.8	21.6	15.4
Haryana	4.4	6.0	5.8
Karnataka	10.7	14.7	16.8
Kerala	8.0	11.0	11.2
Madhya pradesh	15.5	21.2	23.3
Tamil Nadu	15.0	20.5	21.3
Maharashtra	26.3	36.0	28.0
Orissa	8.1	10.9	11.6
Punjab	6.8	9.3	7.6
Rajasthan	9.6	13.1	15.8
Uttar Pradesh	31.9	43.7	50.5
West Bengal	21.0	28.8	24.4
Others	7.4	10.4	9.7
Total	228.6	313.0	313.0

and consumption patterns and other components for export, for open market operations and for emergency. It is necessary to identify each component and its size. From the statistical data presented earlier, it may be observed that matching of production and consumption patterns requires the maximum amount of carry over stock. This may be as large as 33% on an average and in years of surplus or plenty it may be as high as 60% of production. In comparison, stocks required to be maintained for supporting export programme, open market operations and emergency programmes pale into insignificance.

15. Diversion of Levy Sugar

In the past government was distributing levy sugar amongst the different States of the Union on the basis of their actual consumption. Now they have shifted to a system of allocation based on population. Since the advanced States have higher per capita consumption, they receive a smaller allotment than they need, when allotments are made on population basis. In fact from data presented in Table 12, it may be computed that every month 22,300 metric tonnes

of sugar will be diverted from levy stock to the free-sale market. This distorts the market and affects the realisation on free-sale sugar. Such distortion may be affected if the allotments to States are made on the basis of actual consumption as in the past.

16. Price Trends :

In general, sugar prices have tended to rise steadily as a consequence of the prevailing inflationary trend all over the world. However, we must remark on two important aspects of sugar prices in India, viz. (i) How retail price of Sugar in India compares with retail price of sugar in other countries of the world. (ii) How increases in sugar prices compare with increases in prices of other items of essential commodities like food grains, pulses, fruits and vegetables, vanaspati etc. In table 13 we have presented data on retail price of sugar in various countries of the world. It may be noted that average retail price of sugar (weighted average of levy and free sale sugar prices) in India was amongst the lowest in the world. Similarly in table 14 we have presented yearwise index numbers of wholesale prices for the financial years 1973-74 to 1985-86, for all commodities as well as for some important essential commodities. During this period of 13 years the price rise allowed in the case of sugar was only 19% as against 156% for all commodities taken together and 160% for pulses, 152% for Khandsari, 148% for fruits and vegetables, etc. From this it is seen that the sugar prices are usually pegged at a level substantially below that permitted for other essential commodities.

17. Uneconomic Price Of Levy Sugar :

A most disturbing aspect of the sugar pricing policy of the Government is the fixation of levy price of sugar at an uneconomic level. Till 1985-86 the levy price of sugar was below the ex-factory cost of production of sugar. We have presented in Table 15 a statement showing the cost of production and ex-factory selling price of sugar for the years 1978-79 to 1982-83. Throughout this period the levy price of sugar continued to be below the full cost of production. As a result of this policy sugar production became depressed and sugar consumption was stimulated. The net result was that India which was an exporting country has again become a net importer of sugar. Though late Government of India have now recognised that a reasonable cane price cannot be paid to the growers without securing a reasonable price for sugar. Consequently, a reliable realistic sugar policy was, for the first time,

(Contd. on Page 275)

Table - 13

RETAIL PRICE OF SUGAR IN VARIOUS COUNTRIES AS ON 1.4.86

(Rs. per kg.)

Finland	20.57
Japan	19.26
Denmark	16.84
Norway	13.74
Sweden	12.34
Austria	11.81
U.S.A.	10.46
Italy	10.16
West Germany	10.06
Pakistan	10.00
Belgium	9.86
Spain	9.41
France	9.33
U.K.	9.06
Bangladesh	9.00
Greece	7.77
Switzerland	7.27
Canada	5.84
Malayasia	5.81
Singapore	5.71
South Africa	4.40
Brazil	3.57
India (Average levy & free)	5.00 *

	*Retail Rs/kg.	Less Excise Duty & Development Cess	Balance
Levy	4.80	0.52	4.28
Free	6.50	0.64	5.86
Average of levy & free	5.57	0.57	5.00

SUGARCANE CULTIVATION IN INDIA

C.B. AGNIHOTRI

India has the largest Sugarcane area and production in the world. The Sugarcane is grown in between latitude about 10° to 30° north of equator and from longitude 75° to 94° east of Greenwich Line. The cultivation is however not carried out in mountainous or on hills which are snow clad or extremely cold. Similarly, the cultivation is not possible in desert areas of Rajasthan which have acute scarcity of water and the day's temperature goes as high as 45°C under shade during summer and touches as low as 1°C during winter i.e. December and January. Thus the Sugarcane cultivation in India is carried out under very varied climate and soil conditions. Geographically, the cultivation is carried out under two distinct belts based on Agroclimatic conditions namely :

1. The tropical belt and
2. The sub-tropical belt.

Sugarcane is basically suited to tropical conditions. The temperature between 24° to 30° is ideal for having good crop of Sugarcane. Similarly, the sugar recovery is better, in areas having bright sunshine, dry and cool climate during its ripening period.

The important cane growing States of the tropical belt are Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu, Gujarat and Orissa. The temperature variation, in tropical belt is on an average 10° to 12°C, but it never drops to 5°C. Under these conditions, the cane growth and accumulation of sugar continue for longer period, accounting for higher yield and sugar recovery. The ecological conditions contribute to the extent of 60 percent in production of a crop. Thus, in tropical belt, the cane yield i.e. tonnage per Hect. and the sugar production is higher to North India. However, the cane yield and sugar recovery vary considerably in between the states, situated in the same belt, due to variation in temperature, rainfall, humidity and bright sun light hours, soil type, availability of water for irrigation and the crop management practices adopted. For example, in coastal areas of Tamil Nadu, Andhra Pradesh and Kerala the sugar recovery is low as the humid and warm climatic conditions are favourable for vegetative growth of the crop and affects ripening of cane.

The Agroclimatic conditions of the Subtropical belt i.e. North India, comprising of the important cane

growing States of Uttar Pradesh, Bihar, Haryana, Punjab, Madhya Pradesh, Rajasthan, West Bengal and Assam differ considerably with that of the tropical belt. The conditions further differ from state to state or region to region. The climate of Western Uttar Pradesh, Haryana, Punjab and Rajasthan is extreme the maximum temperature ranges in between 35° to 40°C and the minimum is as low as 5° to 7°C. In Rajasthan, particularly in the sugarcane growing area of Sri Ganga Nagar, there is wide difference between day and night temperature. The day's temperature under shade goes upto 45°C during May and June, and during December and January it falls as low as 1°C. This entire region is prone to frost. The extreme climatic conditions, particularly the cool night temperature of 14°C or below have a deteriorating effect on the growth and development of the crop and sugar recovery.

Rainfall

In India there is wide variation in Rainfall in between region to region and state to state or within state itself. There are two main periods of precipitations. One in rainy season (May - September) nearly 75% of the total annual rainfall occurs during these months. The second precipitation takes place during winter months (December - middle of February). The average annual rainfall in India is 105 cm.

The rainfall and its distribution has a direct bearing on the temperatures and humidity. The excess rainfall and lesser evaporation causes problem of drainage, while lesser precipitation and higher rate of evaporation indicates requirement of Irrigations.

In the tropical belt the higher rainfall in Tamil Nadu (about 770 cms), Kerala (about 300 cms) and in coastal areas of Andhra Pradesh, besides causing problem of drainage adversely affect the formation of sugar recovery due to high humidity and narrow diurnal fluctuations in maximum and minimum temperature which remains about 10° to 12°C. The average annual rainfall in Andhra Pradesh is 75 to 100 cm, in Maharashtra is 50 to 90 cm, Karnataka 135 cms and Gujrat gets 50 to 100 cms precipitation most of it during the rainy season. The sugar recovery in these States is better than other States.

The rainfall in the subtropical belt varies from East to West. The maximum average annual rainfall

of about 250 cms is recorded in Assam followed by 114 cms in West Bengal. The floods and inundation of vast areas under water is a common feature of these States. In Bihar, the average annual rainfall varies from 80 to 140 cms. Most of it is received in Northern region. The rainfall in Uttar Pradesh ranges in between 80 to 140 cms. The North Eastern part of Uttar Pradesh and areas situated in foot hills commonly known as Terai, receive maximum precipitation while the rainfall in Western region is less. The areas of North Bihar and the adjoining areas of North Eastern Uttar Pradesh are subjected to waterlogging or stagnation of water for longer periods during rainy season. The yield and sugar recovery in all such areas is comparatively low.

As one proceeds in West the rainfall recedes. The States of Haryana and Punjab get annual average of about 65 to 75 cms rainfall only. The rainfall in Sri Ganga Nagar District, situated in the Northern region of Rajasthan is only 20 to 30 cms annually, while the Southern region receives 70 to 90 cms rainfall. In Madhya Pradesh the average annual rainfall is 110 cms which can be considered as moderate.

Soils

Besides, temperature and rainfall, the type of soil also determines the suitability of an area for cultivation of sugarcane. It grows well in loamy soil with proper drainage.

The soil of Southern India have been classified on the basis of parent material and on other climatic and weathering factors, including drainage characteristic. These can be broadly classified as coastal Alluvial and saline soils, (2) Laterite soils, (3) Red & Dark Brown soils, and (4) Black and Calcerious soils.

In North India, the soils of important cane growing states like Uttar Pradesh, Bihar, Haryana, Punjab and West Bengal are alluvial and have been classified by variation to the extent of leaching and deposits of Calcium or Sodium Carbonate, based on the rainfall of the area and its topography. These soils by and large are deep, rich in nutrients and have good water holding capacity. The soils of Assam and West Bengal are susceptible to erosion. In Assam, the cultivation is made on "Tila" lands i.e., on hillocks. In Rajasthan the soils are sandy loam to light clayey loam. The soils of the South Eastern region of the State are medium black to black and are fertile. Similarly in Madhya Pradesh, the sugarcane is grown on Alluvial soils and also on black cotton soils which are clayey loam in texture.

Irrigations

Depending upon the Agro-climatic conditions, soils and duration of the crop, about 25 to 35 assured light irrigations are given to the sugarcane crop in Southern India as against 0 to 10 irrigations given in North India. During summer months on account of

scarcity of water, only 4 to 6 irrigations could be given to the plant crop in Bihar and Eastern part of Uttar Pradesh. In Haryana & Punjab, the crop is provided with 6 to 8 premonsoon and 1 to 2 postmonsoon irrigations, while at Rajasthan 3 to 4 premonsoon and 2 to 3 postmonsoon irrigations are made available to the crop depending on the availability of water.

Fertilizers and Manures

Besides providing basal application of Organic Manures like Farm yard manure, compost, pressmud of sulphitation units or green manuring by the crop of Sanai (*Crotolaria juncea*), Dhaincha (*Sesbania aculeata*) or Lobia (*Vigna Catzang*), the application of fertilizers vary considerably in North and South. With assured irrigation and long duration of the crop in the field higher doses of fertilizers (N.P.K.) are provided to the crop in Southern belt as compared to North. The requirement of Phosphate and Potash is much less in the soils of North India. While in South India these are also needed in adequate quantities. The Statewise fertilizers requirement of sugarcane crop in each of the belt is summarised as per details given in Table 1.

Under North Indian conditions comparatively lesser quantity of the essential nutrients i.e. Nitrogen, Phosphate and Potash are provided to the crop due to limitations of the availability of water during premonsoon period, and also on account of the shorter duration of the crop. Even the recommended doses of nitrogen are often not made available to the ratoon crop, primarily due to scarcity of water for irrigation. The soils of cane growing areas of Uttar Pradesh, Haryana and Punjab are usually not deficient in phosphate and Potash. It is needed only in certain pockets. The recommended doses of Fertilizers in each of the state lying under sub Tropical belt are given in Table 2.

Planting Season, Duration of the Crop and Seed Material

The agroclimatic conditions of South India are so favourable that cane planting is made for 6 months to 10 months in a year. The time of planting, duration of the crop, and the seed etc. of the important cane growing states of Southern India is given in Table 3.

The planting is done in furrows, trenches or pits. The furrows are 15 to 20 cm deep and about 20 cm wide. The inter spacing in between rows is kept at a distance of about 90 cm. In Andhra Pradesh a spacing of 80 cm is advocated. The size of the pits is kept as 6 x 6. The soil at the bottom is loosened and setts are placed in the centre of the trench or furrows with buds on sides. However, in Tamil Nadu, in areas where water logging occurs, the cane setts are planted at the side of the ridges in a slanting position (Partha method) with one bud inside the soil. Similarly, in Maharashtra dry and wet planting is prevalent. In dry planting, irrigation

is given after planting and covering of the setts with 4 to 6 cm soil. It is usually done in deep soil area. The wet planting is followed in light and medium soil, where irrigation is first given in furrows or trenches and the cane setts are placed and pressed in it and covered lightly with soil. Thus planting techniques differ according to the local situations and soil conditions.

The higher seed rate is kept due to lack of sufficient soil moisture at the time of planting and also as farmers consider it necessary to improve the germination percent in case of delayed planting.

Normally, cane seed is taken as a whole stick of cane, with dry leaves and the green crown being removed at the site of the planting, while in many areas of peninsular India, the seed is procured in the lots of one thousand three budded setts from the seed supplier.

In North India, excluding Assam and West Bengal, there are two distinct cane planting seasons i.e. spring and autumn. The cane is planted after giving a light irrigation to the field to maintain soil moisture. The details of cane planting season and duration of the crop etc. are given in Table 4.

The cane planting is commonly made in furrows opened by a double mould board plough or a ridger. The trench planting is made only in light soil, where adequate irrigation is available. The three budded setts are placed in the centre of the bottom of the furrow or trench, with buds on the sides. The distance from furrow to furrow in Uttar Pradesh, Bihar and Assam is usually kept as 90 cm. Narrow spacing is adopted in poor soil conditions, where the tillering is lower and canes thinner with a higher population. In Punjab and Haryana, the closer spacing of 60 to 75 cm is recommended, while in West Bengal it is 65 cm. The higher seed rate is

used, where adequate irrigations and other inputs are available to the crop. In Madhya Pradesh, dry and wet methods of placement of setts are followed. In clay soils, cane setts are placed in dry furrows, covered and thereafter irrigation is given to provide sufficient soil moisture for sprouting and germination of buds. The wet method is followed in Coarse Textured soil where cane planting is made after giving light irrigation to the field. This practice is commonly followed in most of the North Indian States.

Seed & Soil Treatment

The dipping of setts in 0.15 percent solution of organomercurial compound (active ingredient) viz. 0.5 per cent solution of organomercurial compound of 3% strength prepared by mixing 500 gms. of M.E.M. 3 per cent in 100 lts. of water is enough for the treatment of seed to be planted in one Hect. It improves germination of buds. For the treatment of the soil, sprinkling of 6.25 lts. of Gamma BHC (20 percent B.C.) or Heptachlor (20% E.C.) at the rate of 5 lts. per hectare mixed in 1235 lts. of water over the setts before they are covered with the soil, save the crop from the damage of termite; and early shoot borers. The application of 30 kg. of Aldrin (5 percent) or 25 kg. of BHC (5 percent) dust per hec. in furrows or trenches controls termite. However, sometimes due to non-availability of the material at the time of planting, these recommendations are not rigidly followed by the small cane growers of Uttar Pradesh and Bihar, but their application is gradually gaining favour, in many cane growing areas in India.

Varieties

Breeding has been the pivot of varietal development in India followed at the Sugarcane Breeding Institute Coimbatore and also at Hebbal (Karnataka) and Pusa

Table 1
Requirement of Fertilizers for the Sugarcane Crop (Kg/Hect)
(Tropical Belt)

Sr. No.	Name of State	Nitrogen Average			Phosphoric Acid Average			Potassium Average		
		Adsali Crop	Seasonal Crop	12 months duration crop	Adsali Crop	Pre-Seasonal Crop	12 months duration crop	Adsali crop	Pre-Seasonal crop	12 months duration crop
1.	Maharashtra	400	250 to 340	170 to 250	170	170	115	170	170	115
2.	Karnataka	-	187 to 275	-	-	75 to 125	-	-	75 to 125	-
3.	Andhra Pradesh	400	112 to 168	250	Phosphatic and Potassium fertilizers are applied only where soils are found deficient in these nutrients.					
4.	Tamil Nadu	-	175 to 275	-	-	62.5	-	-	112.5	-
5.	Gujarat	-	250	-	-	125	-	-	125	-
6.	Orissa	-	200	-	-	100	-	-	60	-

N. B. : Full dose of Phosphate and Potash is applied at the time of planting while the Nitrogen application is made in two or three doses, after giving the basal dose at the time of planting of the crop. The subsequent doses are provided at different intervals which vary according to local conditions.

(Bihar). The Co, canes have dominated large areas in the country, though B.O. varieties are also popular in Bihar and Uttar Pradesh. However since forties emphasis has also been placed on the development of cane varieties suited to local conditions. As a result a number of Cos, Coj, CoA, and Coc varieties have found favour with the cultivators.

In a varietal composition, the proportion have to be kept at 25%, 50% and 25% for early (including Ratoons), mid-season, and late varieties respectively. Such a varietal mix determines the optimum level of cane and sugar production in the region or area of adoption.

The state wise list of approved and recommended varieties is given as under on the basis of the information collected from Indian Institute of Sugar Cane Research Lucknow.

Andhra Pradesh

COA, 7601, 7701, Co419, 975, 62715 and 997.

Madhya Pradesh

COS 245, Co 419, 421, 521, 617, 678, 775, 779, 853, 1101, 1169, 1305 and 1307.

Uttar Pradesh

COS 687, 767, 802, 837, 7918, Bo 91, UP 1 and 3 Co 1148, 1158.

Haryana

Co 975, 1148, 1158, 7314, 7717.

Karnataka

KHS 2045, IC 225, Co 419, 449, Co 740. 62175.

Assam

Co 313, 740, 961, Co 740 Co 961 997.

Gujarat

Co 419, 775, 791, 995.

Kerala

Co 449, 785, 997.

Maharashtra

Co 419, 678, 740, 775, 798, 7219.

Table 2
Statewise Recommended Doses of Fertilizers (Kg. per Hect.)
Sub-Tropical Belt :

Sr. No.	Name of the State	Nitrogen	Phosphate	Potash
1.	Uttar Pradesh			
	(a) Autumn Planting	180	To be applied in deficient soils.	
	(b) Spring Planting	150	40 to 50	20 to 30
2.	Bihar			
	(a) North Bihar			
	i) With adequate irrigation facility	120	85	30
	ii) With inadequate irrigation facility	70	85	30
	(b) South Bihar			
	i) With adequate irrigation facility	140	70	30
	ii) With inadequate irrigation facility	90	70	30
3.	Haryana	150	* 50 *	-
4.	Punjab	150	To be applied in deficient soils as recommended.	
5.	Madhya Pradesh	300	80	40
6.	Rajasthan	100 to 170	50 to 60	-
7.	Assam	130	60	60
8.	West Bengal	160	60	60

* Recommended only in Teh. Jagadhri of Distt. - Ambala & Ladwa Dev. Block of Distt. Kurukshetra.

Orissa
Co 419, 527, 740, 975, 997, 1053, 62175.

Punjab
COJ 64, Co 1148.

Chennai
Co 658, 740, 853, 6304, BO17, COL 29, COS 245.

Rajasthan
Co 312, 419, 449, 527, 997, 1007, 1111, 1253.

Nagaland
Co 419, 421, 740, 961, 997.

West Bengal

Bo 17, Co 313, 419, 527, 622, 801, 842, 997, 1008, 1132, 1232, 62015, 6315.

Tamil Nadu

COC 671, 771, 779, Co 419, 449, 740, 853, 62198, 6304.

Ratoon

The practice of taking the ratoon crop after harvesting the plant cane helps in reducing the cost of production of the cane crop. It reduces the crop cycle, and is

Table 3

Sr. No.	Name of the State	Time of planting	Duration of the crop	Seed rate per Hect.
1.	Maharashtra	1. Adsali crop - July & August	16 to 18 months	25 to 30000 three budded setts are planted end to end.
		2. Pre-seasonal or autumn crop - Oct. & Nov.	15 months	
		3. Saru crop - Jan. & Feb.	12 "	
2.	Karnataka	1. Adsali crop - July & August	16 to 18 "	25 to 30000 three budded setts are used
		2. Autumn crop - Oct. & Nov.	12 to 14 "	
		3. Spring planted crop - Jan. & Feb.	10 to 12 "	
3.	Andhra Pradesh	1. Adsali crop - Aug. & Sept.	18 to 20 "	30000 three budded setts.
		2. Eksali crop - Dec. to March	10 to 14 "	
		(a) Early varieties Dec. to Jan.		
		(b) Others - Jan. Feb. & March		
4.	Tamil Nadu	1. Main Season - Dec. to May	12 months	37 to 45000 three budded setts or
		2. Special season - July to Sept.		75000 two budded setts
5.	Gujarat	1. Ekasali crop - Jan. & Feb.	12 to 14 "	25 to 30000 three budded sets.
		2. Pre-Seasonal crop - Oct. & Nov.		
6.	Orissa	October to March (Nov. to Feb. is the main planting period)	10 to 14 "	40 to 45000 three budded setts planted end to end.

available for crush in the early part of the season with comparatively better sugar recovery, as it matures earlier.

The practice of raising one and in certain areas two crops of Ratoon is prevalent in North India. In South particularly in Karnataka, Andhra Pradesh and Maharashtra, a crop of Ratoon is also taken. In these states about 30% area is kept under Ratoon crop; the area under Ratoon in Uttar Pradesh is about 56% (1984-85). The exact statistics about state wise area under ratoon

crop, are not available, but on all India basis, it is reported to be in the order of 35 to 40 percent.

The ratoon crop has great potential to improve the economics of cane cultivation, but due attention is not paid by the farmers and it is considered as gift of God. The crop is thus neglected which results into poor production. The experiments conducted in Uttar Pradesh indicates that, first crop of Ratoon yielded 20%, and the second and third crop of Ratoon 30% less cane than the yield of the plant crop. Contrary to this

Table 4

Sr. No.	Name of the State	Time of Planting	Duration of crop months	Seed rate per Hect.	Remarks
1.	Uttar Pradesh	1. Spring - Feb. to 1st week of April 2. Autumn - Mid of Sept. to Oct.	10 to 12 14 to 15	37000 three budded setts	Setts are placed end to end or in a little overlapping position.
2.	Bihar	1. Spring - Feb. to March 2. Autumn - Oct. to Nov.	10 to 12 13 to 15	38 to 40000 three budded setts.	Setts are placed end to end in the centre.
3.	Haryana	1. Spring - Mid of Feb. to March 2. Autumn - 3rd Week of Sept. to 1st week of Octo.	10 to 12 13 to 15	58 to 66700 three budded setts	
4.	Punjab	1. Spring - Mid of Feb. to March 2. Autumn - 3rd Week of Sept. to Mid of Oct.	9 to 10	50 to 55000 three budded setts.	Setts are placed end to end.
5.	Madhya Pradesh	1. Spring - Mid of Jan. to Mid of Feb. 2. Autumn - Oct. & Nov.	10 to 12 14 to 15	25 to 30000 three budded setts.	Setts are placed end to end.
6.	Rajasthan	1. Spring - Mid of Feb. to mid of March 2. Autumn - October	10 to 12 14 to 15	40 to 45000 three budded setts	Setts are placed end to end
7.	West Bengal	Middle of Oct. to Middle of April	12 to 15	25000 three budded setts	Setts are placed end to end.
8.	Assam	January to March	10 to 12	37 to 42000 three budded setts.	Setts are placed end to end.

in Nagaland first crop of Ratoon yields 10 to 12 percent more cane than the plant crop.

Diseases & Pests

Of the 147 diseases reported in sugar cane, all over the world, 84 have been reported to occur in India, though only six of these are of economic importance, namely :

- (a) Fungal : Red Rot, Wilt and Smut.
- (b) Virus : Mosaic
- (c) Bacterium : Ratoon Stunting (R. S. D.)
- (d) Mycoplasma : Grassy shoots disease (G. S. D.)

The Red Rot and wilt diseases, mainly seed born occur in all cane areas, they are wide spread and more damaging in water logged areas of the Sub Tropical North. The Smut disease is prevalent in Ratoon crop of the Tropical Belt. The affected cane in general contains 10% less juice and 3 to 7% less sugar as compared to healthy cane.

Mosaic has become a serious disease through development of more virulent of pathogenic strains causing for more severe symptoms than mottling in Maharashtra, Tamil Nadu, Uttar Pradesh and West Bengal. The disease however does not affect the quality of juice in the affected canes. The R.S.D. and G.S.D. diseases have been noticed in all most all the cane growing states at varying intensity. These can be controlled through heat therapy treatment of the seed.

Pests

The sugar cane is damaged by over 100 species of insects, besides non insect pests - mites, nematodes, rats, squirrel, parrots and jackals etc., right from planting till harvest. Out of this number, about two dozen insects and pests are of economic importance. These include mainly mothborers, scales, termites, white grubs, white flies, black bugs, mealy bugs and leaf hoppers like pyrilla. The losses are comparatively more in the Sub-Tropical North, as compared to the Tropical South, because of lower intensity of damage, and localised infestation. These can be controlled by appropriate and timely plant protection measures.

Crop Management

In the southern States of Maharashtra, Karnataka and Gujarat, besides providing adequate doses of nutrients and assured timely irrigation, the interculture operation viz. Weeding, earthing up and binding and propping etc. of the crop is also done properly. The high yields of cane and sugar in the southern States, besides good crop management are also due to favourable temperature ranging between 24° to 30°C which is optimum for good growth and higher Tonnage. The bright sunlight hours and gradual variation i.e. drop, drop in temperature about 10° to 15°C, but not below 5°C is helpful in formation of higher sugar percent cane. The most important is the harvesting of the crop on the maturity basis. The harvesting and cane supply schedule is based on the date of planting. It, therefore, gives equal opportunity and duration to the crop to grow and develop under field conditions and also for the formation of sugar.

On the contrary in North India, adequate quantity of inputs could not be provided to the crop due to constraints i.e. inavailability of water for irrigation purposes during the summer months. Besides, due to economic considerations, the practice of late planting of cane after harvesting the Rabi crop of Wheat etc. and similarly raising a crop of Rabi season after harvesting weak and neglected crop of sugar cane have an adverse effect on the yield and sugar recovery. In such short duration crop of cane, recommended doses of inputs and other agricultural operations are also not carried out properly. The weak and neglected crop of cane is usually disposed off by the cultivators on priority basis to vacate the fields. It, therefore, results into poor return in the form of yield and sugar recovery. In Punjab however, the comparatively higher sugar recovery is being fetched due to multiplication, propagation of a high sugared and early ripening variety i.e. COJ 64 and its supply to the Mill for crush in the early part of the season, on priority basis.

Sugar Cane Performance

The comparative sugarcane performance in some of the important cane growing States of Tropical and Sub-Tropical belts is given in Table 5.

Table 5

Sr. No.	Name of the State	Irrigation applied approx. inches	Average Nitrogen applied Kg. / Ha.	Average yield MT / Ha.	Sugar Recovery %	Sugar Production (T / Ha)	Duration of the crop days
Tropical Belt							
1.	Maharashtra	95 120	350-450	80 150	11.77 11.77	14.13 17.65	360 540
2.	Karnataka	60 70	200-300	81 100	10.59 10.69	8.58 10.59	360 450
3.	Andhra Pradesh	40 50	100-250	80 100	9.62 9.62	7.70 9.62	360 450
Sub-Tropical Belt							
4.	Uttar Pradesh	15	0-100	39	9.45	3.69	360
5.	Bihar	15	0-175	37	9.59	3.55	260
6.	Punjab	30	0-100	38	9.69	3.29	360

Source : Proc. of the ICAR Symposium of Cropping Pattern in India (1972).

Taken from the book : "Sugarcane" published by The Fertilizer Association of India, New Delhi.

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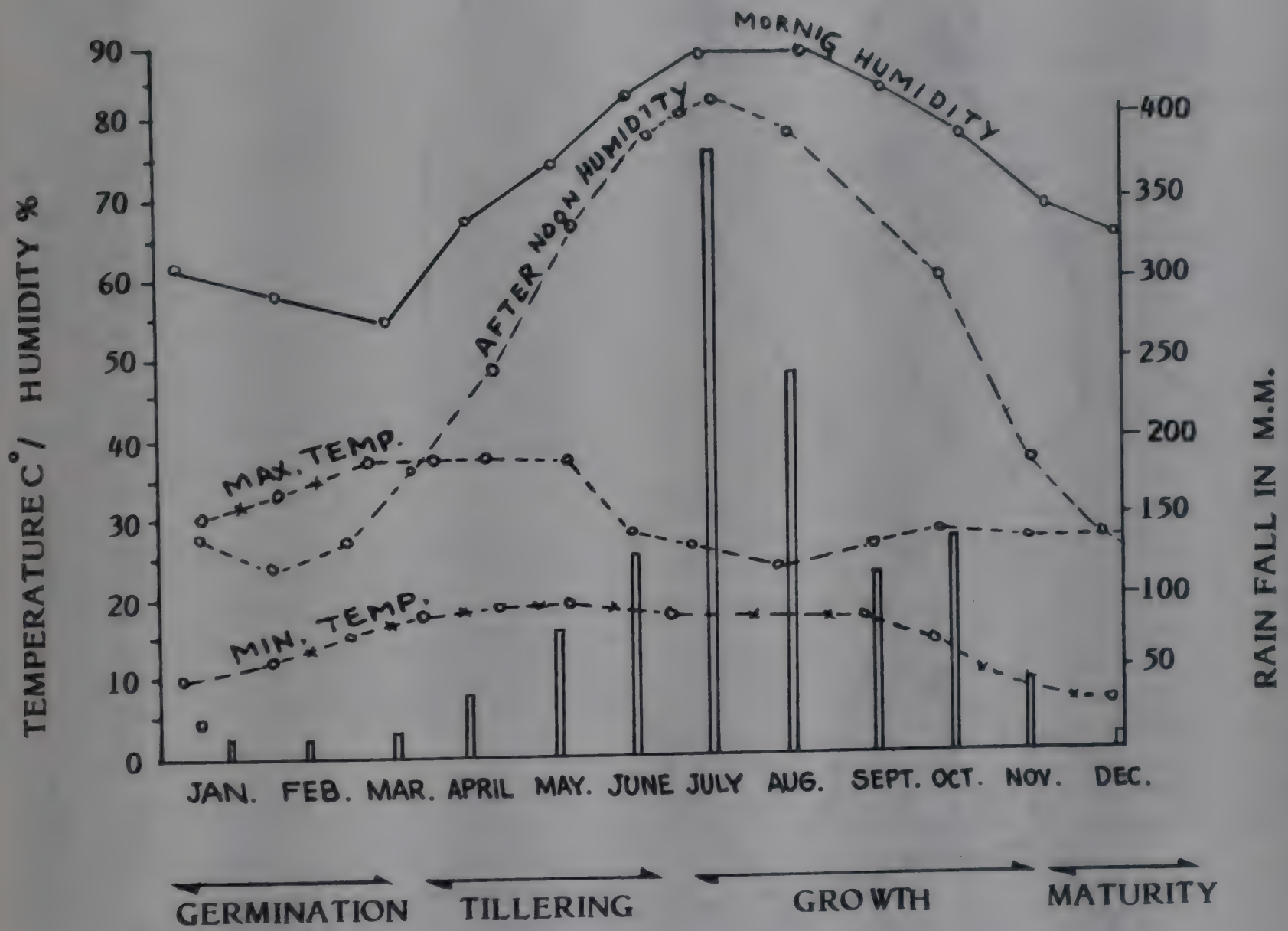
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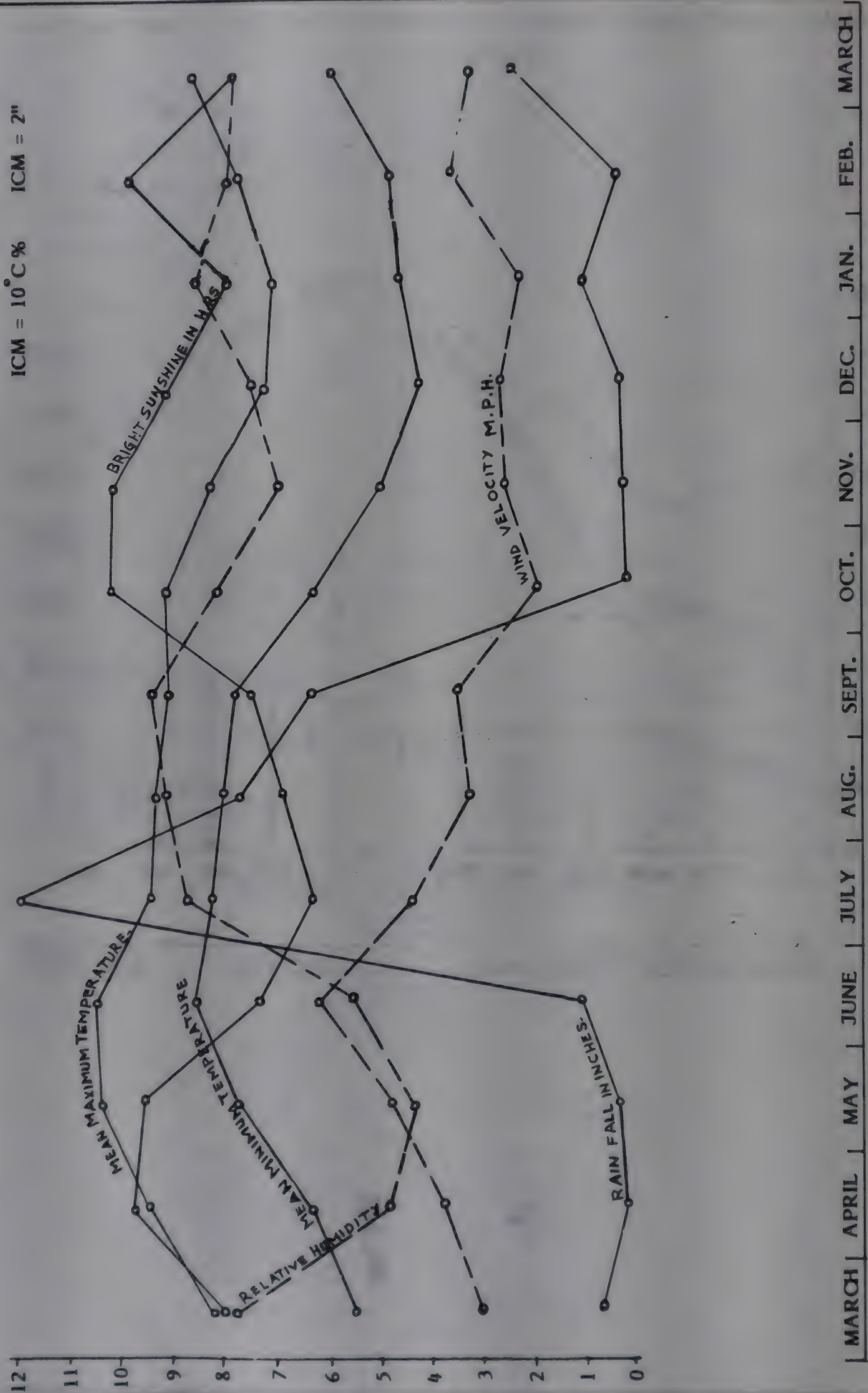
NORMAL WEATHER OF KOLHAPUR AND SUGAR CANE CROP SEASON (TROPICAL B.E.I.T.)

ICM = 10°C
ICM = 10%
ICM = 50 M.M.



WEATHER IN RELATION TO SUGAR CANE CROP

I.A.R.I. NEW DELHI



SUGAR IMPORTS AND EXPORTS BY INDIA

Dr. G. J. Khudanpur

1. Imports are resorted to either to meet short term or long term gap in the supply of a commodity in relation to a desired level of demand for that commodity. In India we resorted to imports initially in the beginning of the 20th Century primarily because sugar was not produced in the country then and there was a good demand for the commodity in the country and the foreign exchange position of the country was very comfortable. India continued to import sugar till the World War II by which time domestic production was adequate to meet domestic demand and pressure of war and transport priorities put to a stop to imports of sugar (see Table 1).

2. The imports of sugar were initially of the order of 28.1 lakh tonnes in 1908-09 and increased to a high of 4.71 lakh tonnes in 1930-31. After that the imports continued to decline due to the development of domestic sugar industry under tariff protection and by the beginning of World War II the import of sugar was totally stopped.

3. Protection was granted to the sugar industry in the year 1932 and within a short space of four years the country became self-sufficient in sugar production. Hence by the 1936 the imports of sugar were reduced to a very nominal figure and with the beginning of World War II the imports of sugar were terminated altogether.

4. It may be noted that before the year 1930 the cane acreage in India was less than 3 million acres, yield of cane per acre was approximately 10.70 tonnes and a very significant quantity of cane was utilised for the production of gur. Sugar was being produced in the country, by refining gur and to some extent directly from cane. All this changed with the introduction of tariff protection for the sugar industry. The cane acreage, yield of cane per acre both increased and sugar production was commenced and expanded to in sugar. The data regarding area and yield of sugarcane

and the production of sugar have been presented in Table 2.

5. The protection extended to the sugar industry made production of sugar directly from cane relatively more profitable than manufacture of sugar by refining gur. Consequently there was a gradual shift from refining gur to manufacture of sugar directly from cane. This may be seen from data presented in Table 3.

6. However since the war days the Indian Sugar Industry has grown rapidly. Further with the era of planning and the planned growth of the cooperative sector of the sugar industry the sugar production in the country has been consistently in excess of the domestic demand. Hence the country was not a net importer of sugar in the period 1937-38 to 1979-80. However, it became a net importer in the year 1980. Since then the balance between domestic production and consumption has been precarious and in 1985 and 1986 the Government of India had to resort to massive imports of sugar (see Table 4) to stabilise prices through building up of buffer stock. However, the 7th Five Year Plan targets indicate the Government's determination to achieve self-sufficiency and eliminate imports by the end of the Seventh Plan Period.

Exports

7. Since World War II Indian Sugar Industry has steadily expanded and gained strength. However, the production of sugar is subject to wide fluctuations and consequently the overall position is tight and buffer stocks have to be maintained in order to maintain stability of consumption. Nonetheless soon it became increasingly clear that in spite of wide fluctuations in the production of sugar the country was developing a clear surplus of sugar.

8. In Table 5 we have presented data on production and consumption of sugar for the years 1960-61 to 1985-86. It may be observed from the data that of

these 26 years in 9 years the production fell short of consumption. However, in the past the size of shortfall was relatively small - never more than 18% of the annual consumption of sugar. All this changed from the year 1979-80 when the quantity of shortfall was as high as 12.50 lakh tonnes and represented 24.47% of the national consumption that year. Further, since the year 1983-84 every year there has been a short fall in production and the shortfall has been massive.

Table 1
Imports of Sugar by India

Years (Period)	Imports	Mean Annual Imports
		(Lakh tonnes)
1908-09 to 1910-11	5.62	2.81
1911-12 to 1913-14	6.25	3.13
1914-15 to 1916-17	4.36	2.18
1917-18 to 1919-20	4.11	2.06
1920-21 to 1922-23	4.09	2.05
1923-24 to 1925-26	5.82	2.91
1926-27 to 1928-29	7.93	3.97
1929-30 to 1930-31	9.41	4.71

Table 2
Area under Sugarcane and Production of Sugarcane & Sugar

Year	Area of Sugarcane (Million acres)	Production	
		Sugarcane (Million tonnes)	Sugar (Lakh tonnes)
Prior to 1930 :			
1923-24	2.62	38.46	-
1926-27	2.70	37.38	-
1929-30	2.90	30.95	-
After 1930 :			
1930-31	2.91	36.35	1.20
1932-33	3.42	50.56	2.95
1935-36	4.15	62.10	9.34
1940-41	3.99	52.00	11.13
1945-46	3.20	47.20	9.59
1950-51	4.21	57.00	11.00
1955-56	4.56	59.80	18.34
1959-60	5.79	103.00	23.84

Consequently as was seen earlier, from data presented in Table 4, the imports rose sharply.

9. Even though there were wide fluctuations in the annual production of sugar and shortfall in production in relation to consumption in some years it is quite clear from an examination of the quinquennial data co-terminus with the periods of the five year plans and plan holiday that average annual production has steadily increased from quinquennium to quinquennium. The average carryover stocks also exhibit a similar trend (see Table 6). Further it may be clearly seen from data presented in Table 7 that every quinquennium has yielded a surplus indicating that export was essential to maintain the balance between availability and consumption. It also indicates the need to maintain a buffer stock to support a steady level of export.

10. India began to export since the year 1957 and has been exporting every year since then. The data

Table 3
Sugar Production from Cane and Gur

Year	Sugar direct from cane (Thousand tonnes)	Factories producing sugar from cane	Sugar refined from gur (Thousand tonnes)	Factories refining gur
1926-27	62.5	25	58.0	22
1930-31	119.8	29	31.8	10
1931-32	158.6	32	69.5	17
1932-33	290.2	59	80.1	27
1933-34	454.0	112	61.1	16
1934-35	578.1	130	39.1	13
1935-36	932.1	137	50.1	13
1936-37	1128.9	140	19.5	9

Table 4
Net Imports of Sugar by India after 1979

Year	Net Imports (Lakh tonnes)
1980	1.27
1981	1.26
1982	-
1983	-
1984	0.64
1985	12.89
1986	17.52

on yearwise export of sugar from India are presented in Table 8.

In the years 1980 and 1981 India's export performance in respect of sugar was not satisfactory. In the year 1980-81 the performance was poor because India did not have adequate quantity of sugar for export after meeting the domestic requirements for consumption. In 1981-82 because of a record production of 84.5 lakh tonnes of sugar, India was able to acquire an export quota of 6.5 lakh tonnes. In view of the comfortable position of sugar stocks in the country in the sugar year 1982-83 Government of India exported 7.24 lakh tonnes of sugar in 1983. After 1983 there has been continuous and large shortfall in sugar production in the country and the country has again become a

net importer. In fact, one of policy goals in the 7th Five Year Plan with respect to sugar is to increase domestic production to a level that would eliminate the need to import sugar.

11. In Table 9 we have presented data regarding the direction of export trade. It is significant to note that the developed countries do not figure in an important way in our exports. Also our exports are mainly to middle east and the littoral states of the Indian Ocean.

Table 5
Data on Annual Domestic Production and Consumption of Sugar in India during the period 1960-61 to 1981-82

Season	Production during the year (Lakh tonnes)	Consumption during the year (Lakh tonnes)	Surplus (+) or deficit (-) (Lakh tonnes)	Surplus or deficit as % of consumption (%)
1960-61	30.21	20.87	9.34 (+)	44.75
1961-62	27.29	26.01	1.28 (+)	4.92
1962-63	21.39	25.02	3.63 (-)	14.51
1963-64	25.73	23.26	2.47 (+)	10.62
1964-65	32.32	24.37	7.95 (+)	32.62
1965-66	35.41	27.92	7.49 (+)	26.83
1966-67	21.51	25.95	4.44 (-)	17.1
1967-68	22.48	22.11	0.37 (+)	1.6
1968-69	35.59	26.09	9.50 (+)	36.0
1969-70	42.62	32.61	10.01 (+)	30.7
1970-71	37.40	40.25	2.85 (-)	7.80
1971-72	31.13	37.95	6.82 (-)	17.9
1972-73	38.73	35.14	3.59 (+)	10.2
1973-74	39.48	35.22	4.26 (+)	12.1
1974-75	47.97	34.35	13.62 (+)	39.6
1975-76	42.62	36.89	5.73 (+)	15.5
1976-77	48.40	37.57	10.83 (+)	28.8
1977-78	64.61	44.82	19.79 (+)	44.1
1978-79	58.41	62.14	3.73 (-)	6.00
1979-80	38.58	51.08	12.50 (-)	24.4
1980-81	51.48	49.02	2.46 (+)	5.0
1981-82	84.35	60.00	24.35 (+)	40.5
1982-83	82.29	64.79	17.50 (+)	27.01
1983-84	59.17	75.46	16.29 (-)	21.59
1984-85	61.44	70.50	9.06 (-)	12.85
1985-86	70.00	82.00	12.00 (-)	14.63

Table 6
Quinquennial Data on carry over Sugar Stock at the beginning of the crushing season for the period 1960-61 to 1981-82

Quinquennium beginning with the season	Quinquennial Average of carry over stock (Lakh tonnes)	Quinquennial Average annual production of Sugar (Lakh tonnes)	Average carry over stock as % of Average production (%)
1960-61	8.28	27.39	30.23
1965-66	8.71	31.52	27.63
1970-71	11.57	38.94	29.71
1975-76	18.43	50.52	36.48
1980-81 *	17.83	67.91	26.56

* Average for the two years 1980-81 and 1981-82

Table 7
Data on quinquennial average annual production and consumption of Sugar in India during the period 1960-61 to 1981-82

For the quinquennium beginning from the season	Average annual production of sugar (Lakh tonnes)	Average annual consumption of sugar (Lakh tonnes)	Annual surplus deficit (Lakh tonnes)	Surplus deficit % of annual consumption (%)
1960-61	27.39	23.91	3.48 (+)	14.0
1965-66	31.52	26.94	4.58 (+)	17.0
1970-71	38.94	36.58	2.36 (+)	6.0
1975-76	50.52	46.50	4.02 (+)	8.0
1980-81 *	67.92	54.51	13.41 (+)	24.0

* Average of the two years 1980-81 and 1981-82

Lists of Exporting & Importing Countries And Territories And Allocation Of Votes

For The Purpose Of Article 75

EXPORTERS

Argentina	24
Australia	81
Austria	6
Bangladesh	5
Barbados	5
Belize	5
Guyana	7
Jamaica	7
St. Kitts-Nevis-Anguilla	5
Trinidad and Tobago	5
Bolivia	5
Brazil	112
Colombia	11
Congo	5
Costa Rica	5
Cuba	118
Czechoslovakia	11
Dominican Republic	36
Ecuador	5
El Salvador	6
Ethiopia	5
European Economic Community	124
Fiji	6
Guatemala	11
Haiti	5
Honduras	5
Hungary	5
India	63
Indonesia	10
Madagascar	5
Malawi	5
Mauritius	12
Mexico	27
Mozambique	5
Nicaragua	5
Pakistan	6
Panama	5
Paraguay	5
Peru	17
Philippines	58
Poland	22
Romania	5
South Africa	38
Sudan	5
Swaziland	5
Thailand	39
Turkey	5
Uganda	5

United Republic of Cameroon	5
United Republic of Tanzania	5
Uruguay	5
Venezuela	5
Zambia	5
Total	1000

IMPORTERS

Algeria	27
Bulgaria	12
Canada	66
Chile	9
Egypt	12
Finland	9
German Democratic Republic	5
Ghana	5
Iraq	25
Israel	11
Ivory Coast	5
Japan	184
Kenya	5
Libyan Arab Jamahiriya	8
Malaysia	23
Morocco	19
New Zealand	12
Nigeria	10
Norway	10
Portugal	21
Republic of Korea	16
Singapore	5
Somalia	5
Spain	24
Sri Lanka	5
Sweden	6
Switzerland	14
Syrian Arab Republic	13
Tunisia	11
Union of Soviet Socialist Republics	105
United States of America	297
Upper Volta	5
Yugoslavia	11
Zaire	5
Total	1000

It may be noted that the exporting members together hold 1000 votes and the importing members together have 1000 votes.

12. The Export policy of the country is formulated by three ministries of the Government of India viz., the Ministry of Food and Agriculture, the Ministry of Finance and the Ministry of Civil Supplies through joint consultation. The exports of sugar are regulated by the Sugar Export Promotion Act of 1958. According to the provisions of this Act the quantity of sugar to be exported in a year is proportioned to the production of factories. The exports are routed through the Sugar Industry Export Corporation Ltd., an organisation of the Joint Stock and Cooperative Sectors of the Sugar Industry, as per the provisions of the Sugar Export Promotion Act of 1958. The Sugar Industry Export Corporation makes payment to the factories for the sugar delivered by them as per their quota. The total sugar receipts are worked out from which the expenditure incurred by the Export Agency viz. the Sugar Industry Export Corporation, is deducted and the balance is distributed among the factories in proportion to the quota delivered by them. Initially

this was so. However, since 1973-74, the sugar exports are channelised through the State Trading Corporation of India (STC) and the Sugar Industry Export Corporation Ltd. acts as the Agent for physical handling of Sugar Export on behalf of STC.

13. The export of sugar was primarily governed by the provisions of the International Sugar Agreement (ISA) as renewed from time to time. The ISA - 1977 however could not be renewed because of lack of consensus amongst the members. However till the ISA lapsed the Sugar Exports were regulated by the provisions of the ISA. The following statement indicates the list of exporting and importing countries and territories who were members of the ISA 1973 and the allocation of votes to them for the purpose of Article 75. the years 1983-84, 1984-85 and 1985-86 in relation to consumption in the respective years an unprecedented situation has arisen and the country has once again become a net importer of sugar instead of a net exporter.

14. The votes of the importing members are distributed among them in proportion to their net imports from the free market and under special arrangements calculated according to the following form :

(a) Each importing member shall have that portion of 900 votes which is average annual net imports from the free market over the preceding four years, disregarding the year of its lowest imports from the free market, bear to the total of such average imports from the free market of all importing members.

(b) Each importing member shall have that portion of 100 votes which its imports under special arrangement for the preceding year bear to the total imports under special arrangements of all importing members for the preceding year.

15. The main objectives of the International Sugar Agreement are as follows :

(a) To raise the level of international trade in sugar, particularly to increase the export earnings of developing countries.

(b) To achieve stable conditions in the international trade in sugar, including avoidance of excessive price fluctuations.

(c) To provide adequate supplies of sugar to meet the requirements of importing countries at fair and reasonable prices.

(d) To increase sugar consumption and in particular to promote measures to encourage consumption in countries where per capita consumption is low.

(e) To promote equilibrium between supply of and demand for sugar within an expanding world of

Table 8
Year-wise Export of Sugar from India

Year	Quantity Exported (Lakh tonnes)
1957	1.47
1958	0.50
1959	0.16
1960	0.18
1961	2.68
1962	3.73
1963	4.79
1964	2.34
1965	2.67
1966	4.41
1967	2.17
1968	0.99
1969	0.94
1970	3.18
1971	3.32
1972	0.99
1973	2.49
1974	4.43
1975	9.66
1976	8.43
1977	2.54
1978	6.35
1979	6.56
1980	0.64
1981	0.98
1982	4.66
1983	7.24

sugar trade.

(f) To facilitate the co-ordination of sugar marketing policies and the organisation of the market.

(g) To provide for adequate participation in the growing access to the markets of the developed countries for sugar from developing countries.

(h) To assess closely developments in the use of any form of substitutes for the sugar including cyclamates and other artificial sweeteners and

(i) To further international cooperation in sugar questions.

16. The importing and exporting countries meet periodically in different places like Geneva, London, New York, etc. and discuss various policies relating to international sugar trade. The decisions are governed by voice of vote, the votes being reckoned on the basis of their allocations to different countries as indicated above.

17. The total 1,000 votes of exporting members shall be distributed among them prorata to the weighted average of the following factors :

(a) Their basic export tonnage or - 50 per cent export entitlements as appropriate.

(b) Their total net exports :

(i) To the free market - 18 per cent

(ii) Under special arrangement - 7 per cent

(c) Their total production - 25 per cent

18. Though India first exported sugar in the year 1956-57 its sugar export were small and insignificant. India was manufacturing white plantation sugar for direct consumption by the domestic market. The exports were also of plantation white sugar but were quiet insignificant in quantity. The surplus production of sugar in the years 1960-61 and 1961-62 and the resulting large carry over stocks of sugar stimulated exploration of the possibilities of export. The need for earning foreign exchange for the developing national economy added to the urgency of the exporting sugar in large quantities. Hence it became necessary to compete in the world market. Though there was short-fall in world production of sugar and hence increase in world demand for exports, India was at a disadvantage because its cost of production of sugar was much higher than the price of sugar in the world market. Hence, if it is to export sugar, this must be at a loss. That is Government must come forward to subsidise the export of sugar. In fact at that time it was worked out that the FOB cost of sugar export was Rs.780/- per tonne while the FOB realisation per tonne of exported sugar would be Rs.350/-. Hence Government had to offer

a subsidy of Rs.430/- per tonne to the sugar factories for their quota of export. However the payment of subsidy is made to Indian national and in Indian currency and hence this represents merely a transfer of income without the countries and the entire foreign exchange earned is an asset to the nation. At that time India was expected to export 5 lakh tonnes of sugar annually and earn foreign exchange worth Rs.20 crores which would go a long way to ease the tight foreign exchange situation. Hence a decision was made to export sugar.

19. However, a large part of the sugar that sells in the world market, is raw sugar. Actually, the practice of manufacturing raw sugar was started in the colonies held by European powers so that they could ship raw sugar and refine the same in their home countries so as to boost domestic employment and income. Hence refineries have come to stay and if India wanted to export any sizeable quantity of sugar on the world market, it had to manufacture and sell raw sugar even though at that time it was manufacturing only white plantation sugar for direct consumption.

20. The importing countries insisted on importing raw sugar only. The specification of raw sugar for the purpose of export was as follows :

Specifications Of Raw Sugar for Export

1. Polarization		96 to 97.9
2. Reducing Sugar	Less than	0.8%
3. Ash Content	Less than	0.54
4. Moisture	not exceeding a safety factor of	0.30
5. Grain Size	0.585 mm sq. to 1.2 mm sq. with a tolerance of 12% less than 0.585 mm. sq. and 15% above 1.2 mm sq.	

The National Sugar Institute, Kanpur, took the lead in the matter and through experimentation at its experimental factory, finalised the process for manufacturing raw sugar and circulated a detailed note on the process to all the sugar factories in the country. The process was successfully adopted by the sugar industry and the raw sugar produced for export by India was later acclaimed to be of the highest quality.

21. Subsequently, the laws relating to import of sugar by U.S.S.R., U.K., Canada and Japan which earlier purchased only raw sugar were modified permitting the import of plantation white sugar of 99.5 pol max. Then the same was treated in the importing country as raw sugar for all purposes and was melted and

reprocessed for manufacture of refined sugar. So India exports these day only plantation white sugar.

22. In view of the substantial rise in the consumption of Sugar in India and sharp decline in production in the years 1983-84, 1984-85 in relation to consumption in the respective years an unprecedented situation has arisen and the country has once again become a net importer of sugar instead of a net exporter. This was basically due to the erroneous policies followed by the Government of India. These policies are in

the process of review and amendment and it is hoped that ere long the country will cease to import sugar. This is absolutely necessary because the import of sugar at that level will cost the country amount Rs.434 crores annually. This is at a time when there is a glut in the World Sugar Market and the prices are quite low. Otherwise the foreign exchange burden of import of sugar would prove quite burdensome particularly in the present critical foreign exchange situation through which the country is passing.

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|---|--|
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| 2. Shri Amarishbhai R. Patel, Vice-Chairman | 10. Shri Hanumantrao Shankar Patil |
| 3. Shri Bhaskarrao Pundlik Patil | 11. Shri Rupasing Manaru Patil |
| 4. Shri Babulal Narayan Agrawal | 12. Shri Bhaskar Namadeo Gangurde |
| 5. Shri Dnyaneshwar Pitambar Patil | 13. Shri Manga Fulla Pawara |
| 6. Shri Bhagawan Danagar Patil | 14. Shri Vishwasrao Vedu Patil |
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**D. C. Narke
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SUGAR INDUSTRY IN CO-OPERATIVE SECTOR - PROBLEMS & PROSPECTS

H. C. Agarwal,
General Manager, NABARD

1. Background

The cooperative sector in the Sugar Industry has played a laudable and vital role during the last three-and-half decades. It contributes over fifty percent to the total production of sugar in the country. With the Government's benevolent attitude and preference in the licensing of new sugar units, this sector has brought prosperity to a large number of sugarcane growers and rural population followed by spread of education and medical facilities and ancillarisation, etc.

The cooperative sugar factory which provided the foundation and which became the trend setter for the sugar cooperative movement in the country was set-up in Maharashtra in 1950-51 at Pravaranagar. This has since been expanded from the initial capacity of 500 TCD to 4000TCD with diversification in the field of spirit, liquor, chemicals and paper. The cooperative sector has taken rapid strides over the years and there are presently 211 sugar factories in the cooperative sector out of 391 licensed factories. In fact, the installed capacity of the cooperative sugar factories stands at 36.00 lakhs tonnes against the total capacity of 67.00 lakh tonnes in the country.

2. Achievements and Shortcomings

The sugar cooperative sector has achieved the distinction of a vital instrument for the industrialisation of rural economy of our country. It has gone to the remotest corner and has been instrumental in changing the entire rural scene. This sector has created employment for as many as 2.00 lakh persons thus alleviating to a certain extent the problem of rural unemployment. Wherever, a cooperative sugar factory has been set-up, it has improved the cane cultivation, developed the infrastructure and irrigation, provided phillip to ancillary industries enhanced the income of vulnerable section of local community and better facilities of school, dispensaries, family planning measures etc.

It cannot be denied that the sugar cooperative sector has a number of glorious achievements to its credit, still one has to ask the question whether all is well in its fabric. The questions that come immedia-

tely to mind are : whether the new sugar units set-up in the previous decades are utilising their capacities to the extent required and they have fared well in reducing the cost of production of sugar and, in general, making available sugar to the consumer at relatively cheaper rates. What has been their performance by way of professionalisation of management, upgradation of skills of employees and awareness of modern management tools coupled with sound financial planning and control? One has to admit that the rapid expansion of the sector has brought in its wake quite a large number of weaknesses and shortcomings. To some extent, the qualitative aspects have been shadowed by the quantitative growth. The success of quite a good number of sugar factories in the past seems to have brought a sense of complacency; the cooperative leadership resting more on its past laurels than striving to improve the productivity and management effectiveness. In fact, there has been hesitancy to professionalise the management; hardly any efforts are being made to adopt costing and cost-consciousness and to streamline the accounting procedure and financial management.

The sugar cooperative sector has the necessary resilience to face and survive the crisis on the weak fronts, and it would be advisable for it to do some self-introspection with a view to improving its productivity, management matrix, control systems, etc., based on the sound and healthy practices.

3. Problems and Remedies

The Industry has not been able to place itself on the path of sustained growth and it is, generally, attributed to wild cyclic fluctuations in production resulting in embarrassing gluts alternating with acute shortages on one hand and the endeavour of the Government to readjust their policies according to the demand of the situation. The pricing of sugarcane and sugar, which have no positive nexus, is also blamed for driving an increasing number of sugar units to the threshold of sickness. It is often advocated that the policy framework/environment is hostile to the well-being of the Industry. Despite that, there are a few oasis with constantly good track record of performance in

the desert of problematic sugar units. The cry for a long-term sugar policy is unlikely to provide any measurable relief as it might turn-out to be a mild pain killer administered in a terminal case. The need of the hour is, however, to improve performance, productivity and profitability of the Industry by paying concerted attention to key weak areas/aspects mentioned hereinafter.

Low Capacity Utilisation

The one single factor that has hindered the prosperity of sugar industry is the low capacity utilisation recorded in a large number of sugar units which arises from a host of factors, such as, (i) unsuitable location of the factory, (ii) inadequate attention to development of sugarcane, (iii) limited involvement of cane growers, (iv) liberal licensing in the proximity of existing sugar factories and (v) non-enforcement regulatory measures on the diversion of sugarcane.

Over-estimation of sugarcane area/production at the time of installation of a new sugar factory or expansion of the existing capacity has, quite often, resulted in under-utilisation of capacity followed by sickness in the sugar units. At times, the management has failed to develop the sugarcane upto the projected level under a time-bound programme and this has impaired the viability of the units. This aspect assumes a great significance in respect of the new sugar units as the quantum of incentives available for an initial period of 5 to 7 years depends on the magnitude of sugar production, and whenever the sugar unit fails to achieve the projected estimates of crushing, it becomes sick 'abinitio'.

There are also a few cases in Andhra Pradesh and Uttar Pradesh where the capacity of the sugar units is under-utilised inspite of abundance of sugarcane around. The reason given even by the sugar cooperatives is that when the gur prices are high, the farmers prefer to convert cane into jaggery rather than supply it to sugar units. To some extent this may be true, but the relationship between farmers and mills in such cases needs a review. It is to be appreciated that the activities of production of jaggery and sugar have to co-exist in a mixed-economy, inasmuch as new sugar units are sponsored on the basis of 'marketable surplus' of sugarcane in the area/district. This aspect was examined by the 'Working Group' on Sugar Industry in 1984, which recommended that, apart from the implementation of comprehensive and integrated cane development programmes, the State Governments should statutorily demarcate the cane areas unit wise, so that the factories may not suffer for want of sugarcane. In respect of cooperative sugar factories, the relevant Act can be suitably amended so as to have a provision for ensuring continuity of supply of sugarcane to the factories by the grower-members. Some suitable

incentives/penalties can also be devised to enable grower-members for continuous and regular supply of sugarcane to the factories with a view to stabilise production of sugar. Further, according to the recommendation of the Group, no new licence may be granted within a radius of 30 kms. of an existing sugar factory.

It is to be appreciated that the 'sine qua-non' of the success of any sugar factory is the availability of sufficient sugarcane of good quality and even the sick unit can become viable and healthy once the cane is made available to it. The case of Satara Sugar Cooperative in Maharashtra is a shining example which attained the prosperity after a problematic period of initial few years. There is hardly any sugar factory with reasonably sound management and a good crushing record which is in the grip of sickness.

Structure and Style of Management

The importance of effective management in cooperative sugar sector needs hardly to be emphasised. The quality has to satisfy the same norms of efficiency and performance as a joint stock company. It has, to be a rational synthesis of democratic management, social objectives and economic efficiency. These multiple tests, more often, make the task of defining a management matrix/structure for a sugar cooperative more difficult which requires a high degree of reconciliation between professional management and democratic control. Even though, the guidelines have been framed and issued with a view to maintain a balance between elected members and professionals in the Board of Directors, but the position in actual experience is wide and varied in different states. A study commissioned by the National Cooperative Development Corporation has shown that a balanced and harmonious relationship between the non-official leaders and professionals is still to be developed. The observations of the said Study Group are relevant in this regard :

- (a) In States like Maharashtra, the non-official leadership is strong and the professional manager feel relegated to the background.
- (b) In many other States, the democratic leadership is, with rare exception, hardly evident and the bureaucratic apparatus is playing a dominant role as the Chairman of the Board of Directors.
- (c) In Uttar Pradesh, the Board of Directors stand superseded and the State civil officers have been appointed as Administrator(s).

Likewise, the concept of professionalisation of management of executives level has not received proper appreciation and attention in most States. Even though, the system of selection and panelisation has

been adopted in Maharashtra and Gujarat, there is a need to provide systematic training and exposition to prepare the executives to meet the challenges from environment with anticipatory vision.

In other States, viz., Uttar Pradesh, Andhra and Haryana, a large number of Chief Executives continue to be drawn on deputation from State Civil and other services. The people taken on deputation have been often found lacking in commitment to the well-being of the sugar factory and in several cases, have been a mis-match to the job due to lack of experience and training in the management of an industrial enterprise. On several occasions, it has been suggested that the State Governments/Federations of Sugar units should create a pool of Chief Executives and key personnel which is still to be adopted. There is a lopsided approach in the sphere of distribution of functions and delegation of responsibility/authority.

The lack of congenial atmosphere and suitable living facilities have often acted as a positive disincentive for competent people in seeking employment in the sugar cooperative sector. The problem is required to be tackled on priority basis with the fruitful exploitation of wherewithall of the sugar cooperative sector to provide professionally competent, stable and effective management for its sustained growth and prosperity.

Financial Policies

The financial information is a key factor for taking management decisions in respect of capital expenditure, economies in cost of production and mobilisation of need-based short and long-term resources. The basic requirement for exercising any financial discipline is systematic and timely finalisation of accounts. Experience has shown that, what to say of day-to-day accounts, even the annual accounts remain pending finalisation for years. This aspect which attracted the attention of NCDC, has been reviewed for corrective measures several times, and despite the fact that National Federation of Cooperative Sugar Factories Ltd. have prepared a Manual, no worthwhile progress has been achieved either in the adoption of the said Manual or improving the effectiveness of the Accounts Department/accounting system in the Sugar Cooperatives.

Management and Allied Issues

There are a number of other grey issues which are equally important for the successful working of any sugar factory. The methodology of fixation and payment of sugarcane price in Maharashtra needs a special mention. The entire surplus arrived by the difference between sale of sugar and expenses in a particular year is passed on to the growers as sugar cane price without retaining any amount as profit/

reserve for utilising the same (a) during the period of set-back in operations, and (b) for financing capital expenditure on expansion, modernisation and/or diversification etc. This is certainly not a sound business policy, and the sugar cooperative sector should give a serious thought to this issue. The argument that the above course is essential to avoid payment of tax does not appear to be correct. In fact, there are a number of ways for tax planning which can be adopted in the best possible way. The collection of refundable deposits out of the sugarcane price by conversion of arrears thereof without any linkage to capital and deployment of the amount for long term uses makes the financial position of the sugar cooperatives quite weak and fragile.

It has also been observed that the value of inventory of stores and spares has increased progressively over the years, and the levels thereof in a number of sugar cooperatives are in the range of Rs.80.00 lakhs to Rs.95.00 lakhs. This phenomenon can be attributed to impulsive purchases and lack of understanding of modern methods of inventory control. Likewise, the control of Budgets and Annual Operating Plans are totally absent in the sugar cooperative sector.

The Central Government has allowed some benefits by way of higher quota of levy-free sugar and reliefs in excise duty to high cost new sugar projects and for expansion schemes. The beneficiaries are required to remit the amount of incentives as also the non-refundable deposits to Financial Institutions towards the repayment/reduction of their loans, but a large number of sugar units in Maharashtra and Uttar Pradesh have not fully adhered to the said requirement, and have unauthorisedly diverted funds for other uses.

Deployment and Development of Manpower

The National Sugar Institute, Kanpur, has provided guidelines showing the staff requirements of a 1250/1500 TCD semi-electric driven sugar factory following the double sulphitation process based on modern sugar plants and the broad break thereof is reproduced below :

(a)	Managerial, supervisory and clerical operatives	66
(b)	Operatives in general shift and workshop	64
(c)	Workers and labour (skill, semi-skilled and unskilled for three shift and relievers)	495

		625

A general review of the staff strength shows that the sugar units have been employing people in excess of the above mentioned norm, and in a few cases, the strength is as high as 1100. It is also observed that there are wide variations not only in the total strength of employees, but also the composition in different grades and categories. Besides, the sugar units engage relievers and temporary hands and pay substantial overtime. It may not be out of place to mention that the wage cost in total cost of sugar production ranges between Rs.25 and Rs.80 per quintal of sugar. Understandably, there is a need for rationalisation of manpower to ensure effective utilisation and optimum productivity. It may be difficult for the existing sugar units to retrench additional hands, but the new sugar units which are under implementation should make sincere efforts to that end.

The development of skills of staff, which is an integral part of personnel management, is yet to find roots in the sugar cooperative sector. A systematic approach towards recruitment, induction, training, performance appraisal, etc., may be adopted by the sugar cooperatives in order to develop right people for different jobs/tasks.

4. Anticipated Scenario

India is the largest producer of sugarcane in the world. The Sugar Industry in India achieved the distinction of the largest sugar producer in 1981-82 when the sugar output reached to a record level of over 84 lakh tonnes. The Sugar Industry has the intrinsic strength to retain the said distinction provided much needed attention is paid to the productivity aspects both in the fields and factories.

The Sugar Industry should also gear itself to achieving higher productivity in the areas of sugarcane production, labour and energy utilisation in order to achieve cost effectiveness. It needs to be appreciated that the additional sugar production has to be obtained through increased productivity by improving the yield per hectare and sugar recovery percentage, and not by only extension of cane area at the cost of food-crops.

The licensing and financing of the new sugar factories in the Seventh Plan Period should be on a selective basis and the sugar factories better adopt the integrated approach both for development of sugarcane and implementation of the project hand in hand.

The concept of 'Performance Audit' might also be introduced to inculcate self-introspection and discipline.

★★★

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NATIONAL CO-OPERATIVE DEVELOPMENT CORPORATION AND SUGAR INDUSTRY FINANCING

N. K. Sawhney

Introduction

The National Cooperative Development Corporation (NCDC) was established under an Act of Parliament in 1962 to plan, promote and assist cooperatives in marketing, processing and storage of agricultural produce and notified commodities. NCDC has been promoting cooperatives in such diverse fields as rural storage, sugar and spinning mills, oilseed and cotton development and processing, handloom and fishery cooperatives, sericulture, rural consumers supplies, marketing of minor forest produce etc. With its annual budget of Rs.2.63 crores in 1961-62 the Corporation's programmes have expanded manifold to a total financial outlay of Rs.129.11 crores in 1984-85 with a provision of Rs.151.55 crores in 1985-86. The Corporation has already invested over Rs.870 crores for cooperative development in the country.

Since 1978, the NCDC has been channelising funds under the World Bank (IDA) and European Economic Community (EEC) projects. The IDA assisted projects NCDC-I and NCDC-II and one EEC project have created facilities for rural storage, cold storage and oilseeds processing, providing the benefit of value addition to the farmers at source. NCDC-I's successful completion this year has created 8.45 lakh tonnes of storage capacity. The 3rd IDA assisted project NCDC-III with an outlay of Rs.505.44 crores also became operational from July, 1984. The project provides for storage capacity of 13.75 lakh tonnes, Soyabean handling capacity of 2.4 lakh tonnes and cotton processing capacity of 1.4 lakh tonnes per annum. The project also has an institution building component for appropriate manpower development.

Administratively, NCDC operates through its Head Office, 7 Regional Offices and 7 Project Offices all over the country. The Regional Offices function primarily as spearhead teams for identification, formulation and monitoring of projects in their jurisdiction supported by the respective project offices. The Head Office provides managerial and technical back up for appraisal of projects, formulation of policies and monitoring of ongoing programmes.

Financial Role

NCDC is unique amongst the following institutions in the country as this is the only organisation at national level which provides risk capital and margin money to cooperatives for expanding their business operations.

Besides providing funds from its own sources the NCDC functions as a financial coordinator vis-a-vis various institutional agencies from which funds are obtained by the cooperatives for their programmes.

Sugar Industry

Since 1963, the National Cooperative Development Corporation has played a pivotal role in the task of building up the country's economy through cooperatives. Its contribution to the development of cooperative sugar sector has been significant.

NCDC provided financial and technical assistance as given below :

I t e m	Figures for the years	
	1962-63	1985-86
Number of mills in production	41	186
Installed Capacity (lakh tonnes)	5.51	42.80
Percentage of installed capacity in the country	22	56.34
Sugar Produced (lakh tonnes)	4.73	41.13
Percentage of total sugar produced in the country	22	58.6

By 1986 the NCDC has provided Rs.73.89 crores for establishment of 113 new cooperative sugar mills and expansion of 6 cooperative sugar factories.

Cooperative sugar mills have been a focal point for rural development. Besides providing a fair return to the grower, they have benefitted all sectors of rural population directly through the spread effects of rural industrialisation. Cooperatives have also played a leading role in socio-economic uplift through provision of medical and educational facilities.

NCDC is proud of its association with the cooperative sugar sector.

This can be stated as :
Centrally Sponsored Scheme for
Share Capital Participation in
Cooperative Sugar Factories
year-wise details of Assistance Provided

Sr. No.	Year	Programme sanctioned (Rs. in lakhs)		Total Funds Released
		No. of Units	Amount	
		New	Expansion	
Before Sixth Plan				
1.	1974-75	11	-	251.00
2.	1975-76	15	-	635.66
3.	1976-77	20	-	870.95
4.	1977-78	18	-	826.87
5.	1978-79	5	-	301.50
6.	1979-80	-	1	230.68
Sub-Total		69	1	3116.66
During Sixth Plan				
7.	1980-81	1	1	180.225
8.	1981-82	5	-	686.845
9.	1982-83	9	-	792.550
10.	1983-84	12	1	1152.125
11.	1984-85	9	3	913.960
12.	1985-86	8	-	887.110
Sub-Total		44	5	4612.815
Grand Total		113	6	7729.475

Sugar Industry occupies a very prominent position on the industrial map of India. It is the second largest agro-based industry having an investment of about Rs.2,500 crores. The Industry has provided employment to more than 3 lakh and several additional lacs of people are indirectly engaged in and benefitted from allied industries.

More than 3 million people who grow sugarcane derive direct benefit in the form of cane price payment. The total output of the sugar mills is valued at over Rs.3500-4000 crores per annum. The sugarcane growers' share amounts to more than Rs.2000 crores for the sugarcane supplied and the national exchequer gets about Rs.400 crores. This indicates the contribution

of the Sugar Industry, its size and contribution to the country's economic life and development.

The Sugar Industry in the country has flourished in phases. Prior to 1932 when Sugar Industry Protection Act came into existence, the industry was facing severe competition from sugar imported from Java. This Act provided protection to the Industry as a protective duty of 7.25% and surcharge of 25% was levied on imported sugar. With this the domestic sugar industry became competitive and in the following years it grew rapidly. Within a period of 4 years the number of sugar mills grew to 130 from 29 and output of sugar went up to 9.47 lakh tonnes from the previous 1.20 lakh tonnes. Again, during the 5 Year Plans there was a substantial increase in the number of sugar factories as well as in the production capacity, as indicated in the above statistical tables.

Currently, there are 397 licensed sugar factories with production capacity of about 87.25 lakh tonnes. One important development during the post-independence period has been the development of sugar industry in the cooperative sector. The cooperative sector which accounted for only about 0.5% of the country's sugar production in 1950-51 has now gone up to about 60%. The total number of factories licensed in the cooperative sector is 216 with the sugar production capacity of 48.78 lakh tonnes. With the increase in the number of factories the sugar production in the country has also gone up substantially. Varying climatic conditions do affect sugar production but the average sugar production has gone up.

Country's sugar production is about 70 lakh tonnes, but it touched 84 lakh tonnes during the year 1981-82, and India emerged as the largest producer of sugar in that year in the World.

Development of the Industry in the cooperative sector has been possible due to a positive preference accorded by the Government to licensing sugar co-operatives. The Industrial Policy Resolution approved by the Government in 1956 stated that the principle of cooperation should be applied wherever possible. Provision of special assistance was made for the enterprises organised on cooperative line for industrial and agricultural purpose. There was the pioneering success of Pravara Cooperative Sugar Factory including the Government, Central Financing Institutions and others concerned with the development of Sugar Industry, to extend all possible assistance and consequently the cooperative sugar sector grew.

Financing of the Sugar Industry has been an important subject due to a variety of reasons. Sugar Industry being capital intensive, offer of financial assistance from the All-India Financing Institutions was inevitable. Most of the sugar cooperatives organised after independence have, thus, received assistance from the financial institutions. The financing institu-

tions have made available a total assistance of about Rs.472 crores to 192 cooperatives.

Looking back at the development of Industry in Cooperative sector, it is noted that setting up Pravara Cooperative Sugar Factory became a trend setter. The farmers as members of this Factory received many benefits adding to their prosperity. The private sugar factories in the neighbourhood were paying only minimum price to the sugar cane growers whereas this cooperative paid a substantial additional amount resulting in a boost to cooperativisation. The members have been supplying 100% cane produced by them to the factory testifying to their faith in the cooperative enterprise. The factory also, in turn, made available a number of amenities like schools, college, medical centre, and other socio-economic-cum-cultural benefits.

As indicated, the sugar industry is a capital intensive industry and as such, the financing of a project needs particular attention. The central financing institutions have been extending the required debt component. However, there have been changes in this policy due to changing parameters of financial performance. Over the years the cost of sugar project has gone up affecting the viability of the industry, and so, the Central Government extended certain benefits to new units to improve their viability.

Financing a project always needs assistance in the form of loan which is provided by the financing institutions. As, interest paid on loans raised, is treated as expenditure, a major portion of total finances should be in the form of debt. This helps the organisation in reducing the tax liability as the taxable profits will consequently come down. This will reduce the overall capital cost for the cooperative thereby making available a bigger amount for payment of dividend.

The Central Financing Institutions which provide the loan follow a particular procedure and also observe a set of principles in sanctioning and releasing the loans. Some of its basic aspects are :

(a) Single Window Clearance

Under the Project Financing Participation Certificate Scheme, one institution out of the three all-India financial Institutions act as a lead institution. For Sugar, the IFCI is such a lead institution in major states. The application is processed on joint financing basis which involves consortium approach. All the three institutions share the resources and risks and also associate in decision making. Though the pivotal role remains with the lead institution the others also share in appraisal and follow-up.

For coordination of the entire gamut of activities, two forums have been created : (i) Inter-Institutional meetings of the heads of the Institutions and (ii) Meetings of the senior executives of these institutions.

(b) Appraisal

Before any project is assisted by these institutions, appraisal of the same is carried out which may take into account capability of the promoter, economic viability, environmental consideration, the overall national policy and the emphasis given in the Plan for the particular industry. In cooperative sector, the promoters are the growers and, as such, it is very essential that the grower-members have a definite linkage with the cooperative and identify themselves as a part of the same.

NCDC has been coordinating with the Central Financing Institutions to get their assistance channelised. At times, when flow of assistance from Central Financing Institutions is restricted, NCDC steps-in to provide a part of the assistance so that the pace of installation is not adversely affected. It has been all along an endeavour of the Corporation to ensure completion of the new units within the stipulated period of 39 months so that the incentives from the Central Government are not denied. This in turn helps in creating the required sugar production capacity in the country. It can be appreciated that the NCDC has played a pivotal role in development of the sugar industry in cooperative sector.

★★★

THE NANDYAL COOPERATIVE SUGARS LIMITED

Ponnapuram (PO), Nandyal (RS) 518 503
Kurnool Dt , A. P.

Tel. (0)754 (R-MD)526

Date of Registration : 24.7.1973

Date of Production : 10.4.1981

Installed Capacity : 1250 TCD.

Key Personnel

Chairman : Sri J. Satyanarayana, IAS,
Dist. Collector, Kurnool

Managing Director :

Sri R. Sudhakar Choudary.

Administrative Officer :

Sri G. Vishnu Murthy

Chief Engineer : Sri A. S. N. Murthy

Chief Chemist : Sri P. Venu Gopala Rao

Chief Agrl. Officer : Sri B.M. Choudary

RECENT ADVANCES IN THE OPEN PAN SULPHITATION PROCESS OF CANE SUGAR MANUFACTURE

¹
N.C. VARMA AND ²M.G. GARG

Abstract

Sugar manufacture on small scale by the 'Open Pan Sulphitation' system is being carried out in India extensively.

A review is made of the developments carried out in this indigenous system of sugar manufacture since 1937.

Important features of development which have contributed to significant improvements in plant and process have been described. The R & D efforts over the last four decades have resulted in improving the recovery level from about 5.5 to 8.2 per cent on cane and the quality of sugar comparable with vacuum-pan sugar.

The most recent advances relate to the development of (i) a Screw Press for the crushing of cane giving a sucrose extraction of about 90 percent as against 80 percent by the six roller mill so far in use; and (ii) a Shell Furnace which is able not only to burn wet bagasse but also make itself sufficient in the matter of fuel.

Introduction

Sugarcane is considered to be a native of India, and sugar has been made from it since times immemorial. The system of sugar manufacture has involved the basic operations of (a) crushing cane for juice extraction, (b) juice purification, (c) juice evaporation to a thick consistency, (d) crystallisation, (e) separation of crystals from molasses and their washing and (f) drying of the sugar crystals.

In the indigenous system, juice extraction was accomplished, ages ago, in a pestle and mortar, using human or animal power. Then came the two roller, wooden or metallic, crushers followed by the three roller power driven mill sometime in the nineteenth century. The juice purification was effected by boiling the juice in hollow hemispherical pans kept over hearths lit by direct fire and skimming off the coagulated impurities from the surface of the boiling juice. Later, vegetable mucilages were used to produce increased coagulation and effect better clarification. The juice, after purification was concentrated to a thick syrup

which was quickly cooled by agitation in shallow wooden receptacles and then moulded into blocks called Gur. For producing crystal sugar, the consistency of the thick syrup was kept somewhat lower than in the case of 'Gur' and this thick syrup was kept and cooled in earthenware pots for static crystallisation. After a few days the earthen pots were broken, the crystalline mass was transferred to hessian cloth bags and squeezed to remove the thick molasses. The crystalline mass still having some molasses was then spread in layers over bamboo mats covered with tank weed or green grass and sprinkled with water, thus draining out the molasses adhering to the crystals and producing an off white sugar which was dried in the sun. This system was known as the Khanchi system. Later, when the centrifugal was invented in 1837, it came to be used in the sugar industry for separating the molasses from the crystals. In course of years it was also adopted in the indigenous system of sugar manufacture in India. For juice boiling, either a single pan was used or two, three, four or five pans were used which were kept over an elongated flue passage of the furnace which had a chimney at the end, to produce a draft. Such a system of furnace with multiple pans kept over the flue passage was called a "BALE".

The entire workshop, where the various operations for producing sugar (khand) by the indigenous system were carried out, was called a khandsar and the sugar produced was called khandsari sugar. Most of the sweetening requirements of the country were met by Gur and Khandsari sugar.

As against the above, the West European countries had developed, following technological advances in beet sugar manufacture, a more sophisticated cane sugar technology than the indigenous Indian system for large scale sugar manufacture. For juice extraction tandems, of a number of large sized three roller mills driven by steam engines or turbines, coupled with

1. Retd. Professor of Sugar Technology, N.S.I., Kanpur
2. Director Projects, Appropriate Technology Development Association, Gandhi Bhavan, Lucknow

suitable cane preparatory devices, were used. For better extraction of sugar, dilute juice and water imbibition was employed. The moist bagasse from the mills was directly burnt in suitably designed boiler furnaces for the generation of steam which was used for juice heating and power production purposes.

Juice was clarified by the lime-defecation, sulphitation or carbonation process. Clarified juice was evaporated to syrup in multiple effect vacuum evaporators and the syrup after sulphitation was boiled to grain in vacuum pans using steam and vapour as heating media. Crystallisation was further effected in crystallisers where the massecuites were kept in motion and exhaustion of low grade massecuite was achieved by regulated cooling and reheating through rotating heat exchange elements fitted in the low grade crystallisers. Crystal separation and washing was effected in high speed semi automatic centrifugal machines. Boiling and curing schemes were so devised as to obtain maximum exhaustion of sugar from molasses and produce one grade of white sugar of desired crystal size. The final sugar was heated by steam or superheated wash water and cooled, over long hoppers to obtain a lustrous dry product which was graded in vibrating graders into desired crystal sizes.

The above system of sugar manufacture was symbolically called the Vacuum-Pan System as against the indigenous Open-Pan System, prevalent in India.

White sugar production by the vacuum-pan system expanded rapidly in India following the promulgation of the Sugar Industry Protection Act in 1932 and reached the million ton mark in a few years time. Earlier, white sugar was being imported from Java (where the Dutch had established a sizeable modern sugar industry) largely for the urban monetary sectors in India and Khandsari sugar was used by the common people. With the establishment of the modern sugar industry in India, imports of white sugar ceased altogether.

In spite however, of the establishment of the modern white sugar industry in India and a sizeable production of white sugar, the indigenous gur and Khandsari sugar industries continued to flourish. This was because sugarcane has been grown and processed all over India since ages as a sort of continuation of the agricultural operations by the Indian farmer. Of the total quantity of sugarcane grown in the country, the white sugar vacuum-pan industry utilised only about 25 percent whereas the gur and Khandsari industries continued to utilise more than 60 percent of it.

Therefore, when an all India Sugar Research Institute (NSI) was set up by the Government of India at Kanpur, in 1936, for the vacuum-pan industry, a Sugar Research & Testing Station (SR & TS) was also established at Bilari, Dist. Moradabad U. P. for

improving the technology of the open-pan system of sugar manufacture.

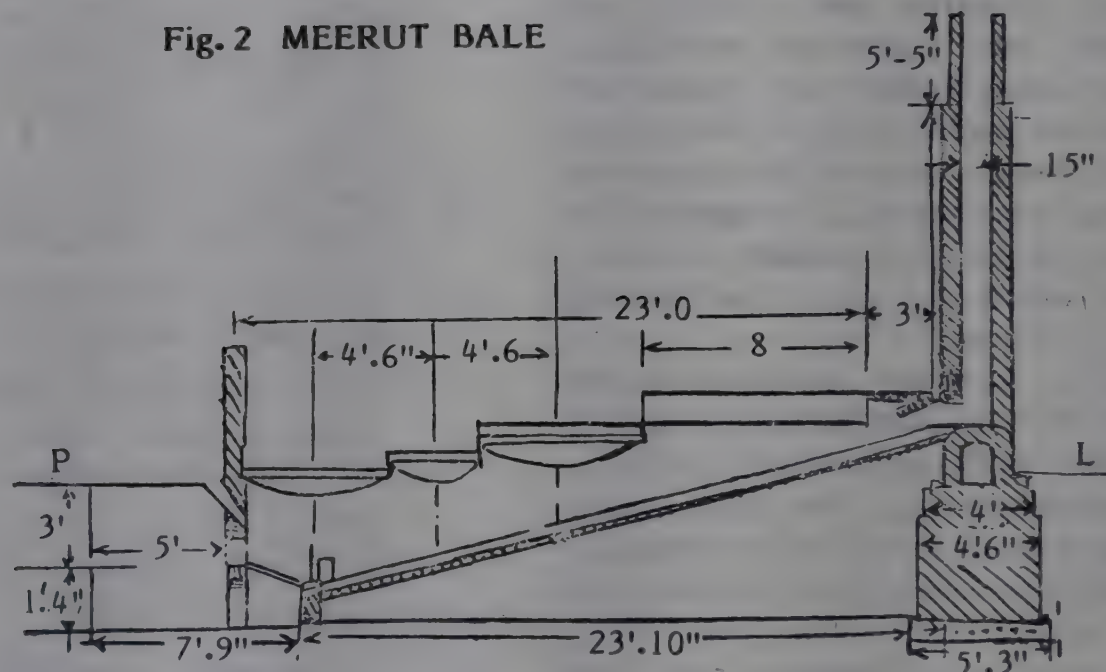
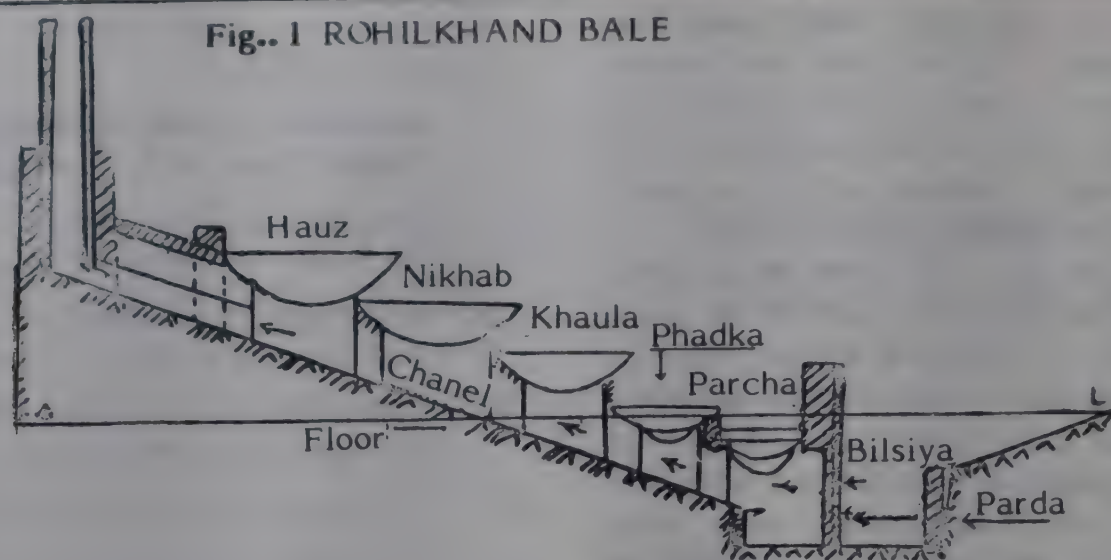
2. Innovations in the Open Pan (O. P.) system made by Sugar Research & Testing Station, Bilari

The SR & TS found that the open-pan system suffered from the following drawbacks.

- (a) Poor juice extraction in the single three roller mill leading to poor recovery.
- (b) Inefficient juice clarification leading to inversion of sugar and poor quality of sugar.
- (c) Inversion and caramelisation of sugar in open-pan boiling.
- (d) Poor fuel efficiency of the juice 'bales'.
- (e) Inability of the bales to burn wet bagasse (about 52% moisture) from the crusher and the necessity of drying it in the sun in open yards to about five percent moisture, involving high labour cost.
- (f) Inadequate and irregular crystal formation in the static mode of crystallisation.
- (g) High labour cost and loss of sugar in the drying of sugar in the sun.
- (h) Inferior quality of open-pan sugar as compared to vacuum-pan sugar, particularly the second and third grades of sugar.

During the course of next decade and a half the SR & TS effected the following improvement in the open-pan technology.

- (a) It designed a six-roller milling tandem with spring loading preceded by a single set of knives, the roller size being 10 inches (dia) x 13 inches (length) the capacity being about two tonnes of cane per hour.
- (b) It adopted the cold juice liming and sulphitation process for juice clarification as against clarification by vegetable mucilages which was effective in the acidic range of cane juice pH of 5.0 - 6.0, thus causing appreciable inversion during juice evaporation and boiling.
- (c) It introduced the settling tanks for treated juice subsidence and close juice decantation and the bag filter for muddy juice filtration.
- (d) It surveyed and tested a number of juice boiling 'bales' in use in various parts of the country such as the (i) Bijnor bale (ii) the Bhopal or Hall bale (iii) the Godavari bale (iv) the Poona bale (v) the Meerut bale and (vi) the Rohilkhand bale. It found that the Rohilkhand bale (Fig. 1) and Meerut bale (Fig. 2) were much better than the others in respect of juice boiling capacity and fuel consumption and of the two, the Meerut bale was faster in juice boiling rate and had consequently lower fuel consumption.



It therefore, selected this bale for improving its furnace efficiency and heat utilisation capacity. It improved the efficiency of the bale by carrying out several modifications in its design features such as providing a hot air supply to the furnace, raising the height of the chimney and replacing the round storage pan by a rectangular long, pan called gutter pan, so as to increase heat absorption from the flue gases. The various pans of the bale were so fixed as to expose the largest possible area of their bottom portions to the hot gases of the flue. The juice boiling rate and fuel consumption improved considerably. This modified bale was called the Improved Meerut Bale.

(e) It designed small sized U shaped open crystallisers to suit the capacity of the plant (30 tons cane/day) for the various grades of massecuites (rab) and adequate number of them were provided, depending upon the time taken for crystallisation of the 1st, 2nd or 3rd rab. It should be noted that unlike the vacuum-pan process where nucleation and part of crystallisation take place in the vacuum-pans, the entire crystallisation

in the open-pan process takes place in the crystallisers only.

(f) Crystal separation was effected in centrifugal machines of suitable capacity having a high gravity factor. All these innovations resulted in improving the recovery of sugar by about 1.5 per cent on cane. As against the average recovery level of 5.5 per cent, a recovery level of about 7.0 per cent could be achieved.

The improved technology was called the open-pan-sulphitation (OPS) system of sugar manufacture.

At this stage the SRTS was closed down but the Government of Uttar Pradesh started a Planning, Research & Action Institute (PRAI) at Lucknow for continuing R & D work for rural industries including the Khandsari sugar industry which was and is a vital sector of rural economy of Uttar Pradesh.

3. Improvements effected in OPS technology of PRAI:

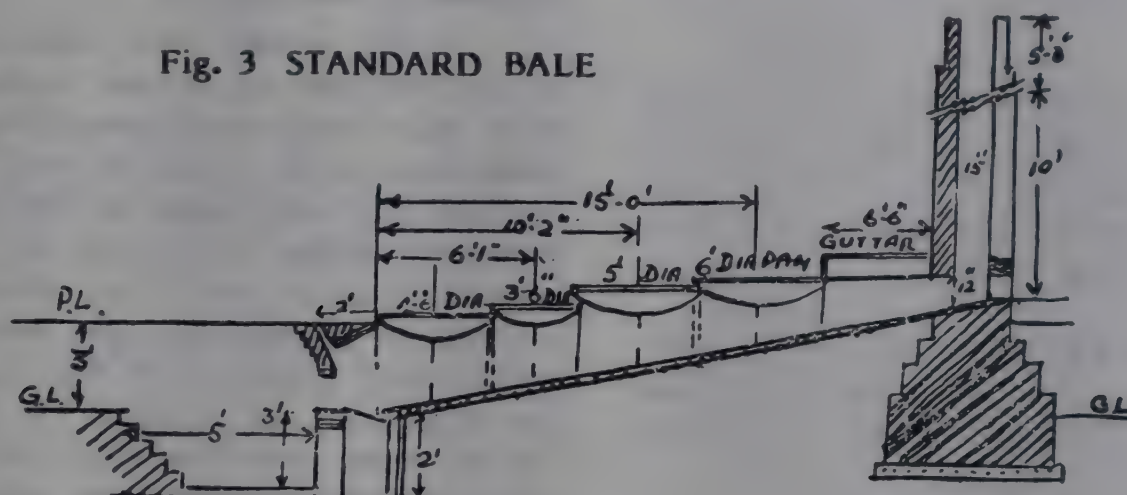
The PRAI put up a complete OPS plant of 30 TCD capacity, worked it for a whole season, collected the necessary data and determined the scope for further improvements.

(a) It designed a six roller hydraulically loaded mill of some what larger roller size viz., 13 inches dia x 18 inches length, reduced the apex angle from 82° to 74°, modified the trash plate design to suit the smaller apex angle, fabricated the headstock of thicker MS plates (18-20 mm) with internal ribs to make it sturdier, provided grooves of one inch pitch on the mill rollers keeping their angle at 55°. The lift ratio of the hydraulic accumulator was changed from 1 : 48 to 1 : 75. It also added a second set of knives. The effect of all these improvements was to increase the crushing capacity to 5-6 tonnes per hour or 100-120 tonnes cane per day. The juice extraction (on dry crushing) improved from 60-62 per cent on cane to 65-68 per cent cane.

(b) The rest of the plant and equipment was redesigned for the increased capacity of 120 TCD.

(c) It further modified the design of the Improved Meerut Bale by so changing the angle of the flue in conjunction with the chimney that proper draft and combustion conditions were obtained for burning fairly dry bagasse which was burnt on a flat grate under the first pan. One more pan was added and the position of the strike pan (Parchha) was shifted from number one place to number two place. Necessary changes in the length, width and height of the inclined flue passage were also effected. This modified bale was called the Standard bale (see Fig. 3)

Fig. 3 STANDARD BALE



It also added a heat recovery unit (Recouperator) for increasing the temperature of hot air supplied to the furnace.

The Standard bale recorded a juice concentration capacity of 150 kg per hour as against 90 kg per hour of Imp Meerut bale. Bagasse consumption (dry basis) of the former was 15 percent on cane whereas that of the latter was 19 percent on cane. The inversion or purity drop in the former was only 1.7-2.0 units against 2.5-3.0 units in the latter.

(d) The operating conditions were optimised.

(e) The PRAI also designed a step grate furnace for the Standard bale for burning wet bagasse but this did not work satisfactorily.

The result of all these improvements was to improve the sugar recovery level by 0.5-0.7 percent on cane over that of the OPS system developed by SR & TS, Bilari.

4. Recent advances in OPS technology by ATDA :

Inspite of the developments made by the SR & TS Bilari and PRAI Lucknow in the open-pan technology, two major problems still remained to be solved satisfactorily. These were :

(i) Lower extraction in dry crushing in the six roller or even nine roller unit of the khandsari plant; only 78 to 80 percent of sugar was extracted in juice percent sugar in case as against 92-95 percent in the large scale milling plants with wet crushing.

(ii) Inability of the open-pan juice boiling bales (Standard bale) to burn directly the 52 percent moist bagasse obtained from the six roller crusher and the handicap of having to dry it in the sun before burning, involving high labour cost and loss of fuel material.

These two problems were taken up for further research by the Appropriate Technology Development Association (ATDA) Lucknow.

4.1 Advent of the Cane Juice Expeller :

In 1965 one Shri Ishwar Bhai Patel (now deceased) proprietor of an oil mill, at Derol, Gujarat, conceived the idea of using the screw press employed in his factory for oil seed crushing, for the purpose of cane crushing. In the demonstration given by him the cane was first chopped into small cylindrical pieces separately in a chaff cutter and then fed into the screw press. The juice could be extracted out of the cane quite successfully but there was the problem of frequent jamming of bagasse pieces in the cage of the press requiring

frequent opening of the press for cleaning and thus making the operation an intermittent one. The authors visited his factory at Derol and made some observations and tests. The results of a few short-duration tests were as follows :

Date 15.2.1966

Sl. No.	Particulars	Ist Test	IInd Test	IIIrd Test
1.	Quantity of cane crushed	2000 Kg	2000 Kg	2116.9 Kg
2.	Time taken in crushing	1 hr 9 m	1 hr 10 m	1 hr 13 m
3.	Net juice percent cane	73.95	73.45	76.3
4.	Bagasse percent cane (by difference)	25.68	24.16	23.24
5.	Juice brix %	17.40	17.65	17.50
6.	Juice Pol %	14.10	14.53	13.90
7.	Juice Purity	81.03	82.32	79.43
8.	Pol % bagasse	5.8	5.9	5.7
9.	Moisture % bagasse	45.2	46.0	41.0
10.	Fibre % Cane	12.25	11.33	12.04
11.	Pol % Cane	11.92	12.39	11.92
12.	Mill extraction (Sugar extracted in juice % Sugar in cane)	87.5	88.46	88.90
13.	Capacity (calculated) in tonnes cane per hour	1.74	1.71	1.74

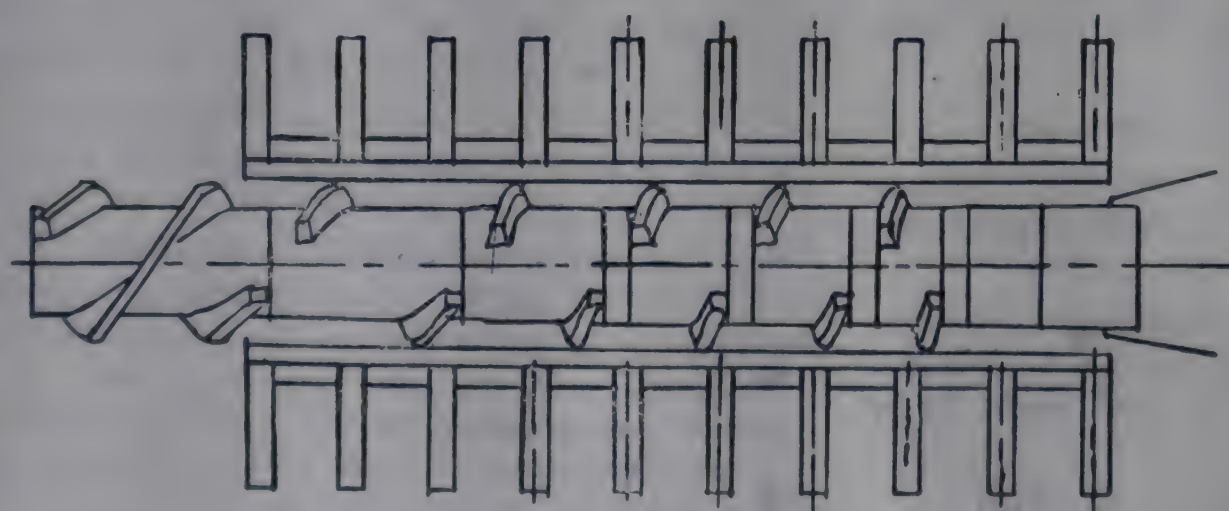
It will be seen that the results relating to sugar extraction were exceedingly encouraging but the working of the screw press (expeller) was very intermittent due to frequent choking of its cages by bagasse. It took a lot of time to open up the expeller to remove the choke and reassemble it for further working. Moreover the power required to work the expeller was extremely high. It was obvious that if the expeller was to be used for cane crushing in a commercial sugar factory it would need drastic modifications in its design features.

This very attractive and challenging piece of research work was taken up by the PRAI under the technical guidance of one of the authors (M K Garg).

The conventional 'Screw Press' used for oil-seed pressing is shown in Fig. 4.

Screw presses have been used since long for various purposes e.g. oilseed crushing, juice extraction from fruits and grasses, dewatering of paper and other pulps, dewatering of bagasse etc. The design features vary for different types of feed materials used, the objective being, continuous or uninterrupted feed, maximum liquid extraction, absence of choking or slipping or compacting and lowest possible power requirement coupled with high capacity. In view of the complicity of a number of factors e.g., feeding force, volume reduction, frictional resistance, strength and material of construction, nature of feed material etc. a mathematical analysis of its operational characteristics, was not possible. Only broad considerations such as, (i) feeding force should be high enough to overcome the resistances met with during compression and twisting by breaker-bars, (ii) this force should be just adequate for cell rupture and proper juice extraction but not so high as to effect compacting

Fig. 4



CONVENTIONAL SCREW PRESS AS USED IN OIL INDUSTRY

A.T.D.A. Gandhi -

Bhavan, Lucknow

Drawn
& Traced

A. Parvez

checked by

V. Sharma

Approved by

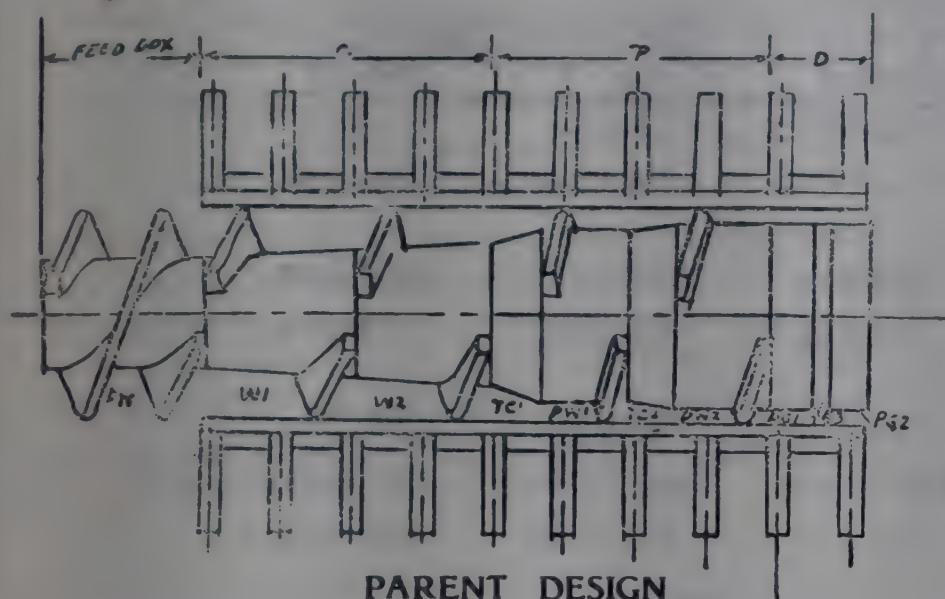
M.K.Garg

and (iii) juice drainage should be so arranged as to prevent its reabsorption by the compressed bagasse, had to be kept in mind.

Therefore, the only course open was to make changes in the various constructional details and observe their effect on the operation of the press. A large number presses with different design details were fabricated and tested with varying results. Each new

trial provided an elucidation of the role played by each of the design features. This helped in arriving at a design which proved successful in regard to continuous operation, good extraction, reasonably good capacity and not very high power consumption. Fig. 5 shows the sketch of the type of press which has proved successful for cane crushing.

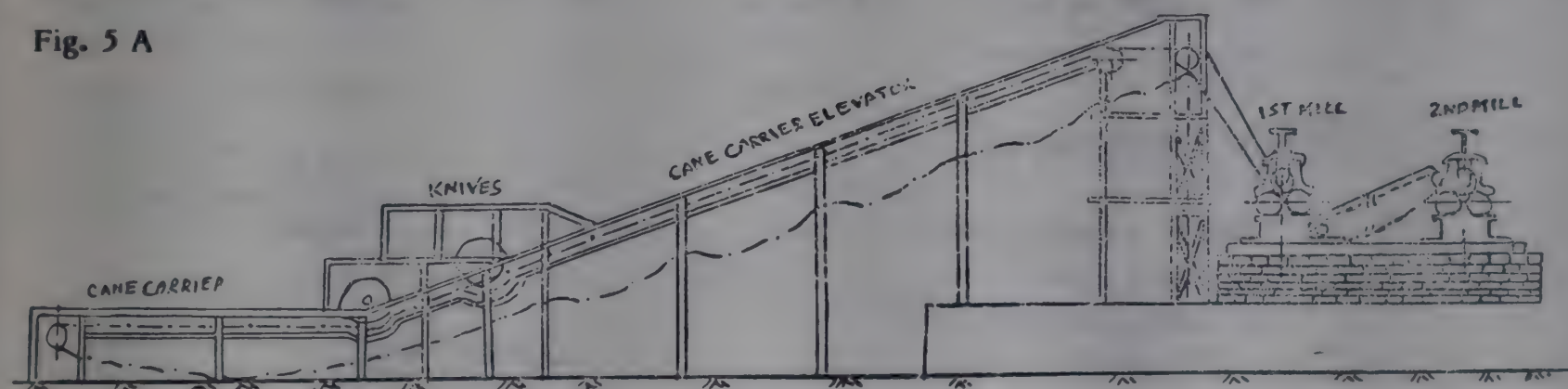
Fig. 5



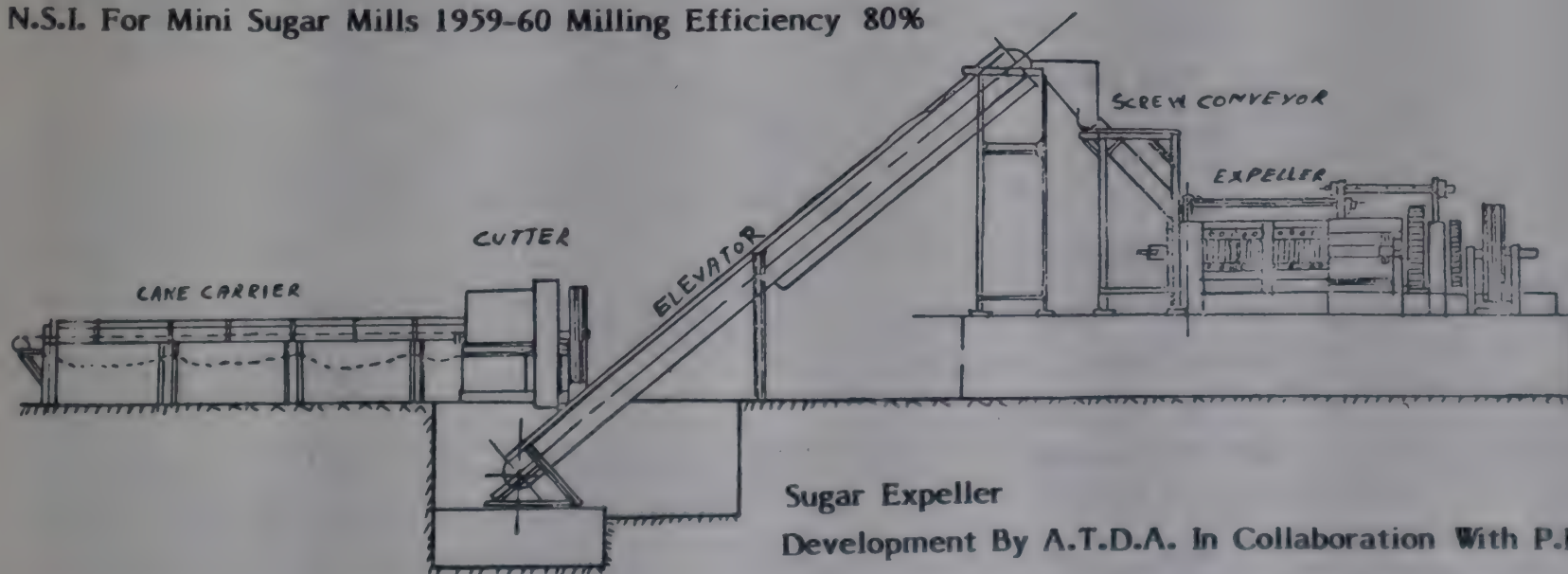
NOTE :

- F.W. : Feed Worm
- W : Feed or Conveying worm
- P.W. : Press Worm
- T.C. : Taper Collar
- P.C. : Plain Collar
- C.: Feed Or Conveying Length
- P.: Pressing Length^{3/4}
- D.: Discharge Length

Fig. 5 A



6 Roller Hydraulic Crusher Developed In Collaboration with N.S.I. For Mini Sugar Mills 1959-60 Milling Efficiency 80%



Sugar Expeller
Development By A.T.D.A. In Collaboration With P.R.A.D.

A comparative mill trial of the conventional six roller (13" x 18") unit was also carried out at the Bhatia Coop. Farm, Jugroonagar, Dist. Bareilly, U. P. Fig. 5A shows sketches of the six-roller mill tandem

and the cane juice expeller tandem.

Two machines of more or less similar design as the above, named BR 7 and BR 7A were subjected to a mill trial.

The results of the tests carried out and observations made on the working of the expellers are given below :

Comparative Test Results of the 6 Roller Hydraulic Cane Crusher and two units of Cane Juice Expeller (BR-7 and BR-7A) carried out at the Bhatia Co-operative Farm, Jugroonagar.

Sl. No.	Particulars	Hydraulic 6 roller Crusher	Cane Juice Expeller	
			BR - 7	BR - 7A
1.	Date of Test	3.2.82	3.2.82	4.2.82
2.	Variety of cane crushed	Co.1148	Co.1148	Co.1148
3.	Gross weight of cane crushed	9218.0 kg	10521.0 kg	11179.0 kg
4.	Weight of Trash	212.0 kg	243.0 kg	278.0 kg
5.	Net weight of cane crushed	9006.0 kg	10278.0 kg	10901.0 kg
6.	Time taken in crushing	1 hr 57 min	4 hr 29 min	4 hr 2 min
7.	Weight of juice (gross)	6048.0 kg	7541.0 kg	8010.0 kg
8.	Bagacilo & dirt correction @ 1.5 %	90.7 kg	113.1 kg	120.9 kg
9.	Net weight of juice	5957.3 kg	7427.9 kg	7890.9 kg
10.	Gross juice extracted % cane	67.16	73.37	73.42
11.	Net juice extracted % cane	66.15	72.27	72.38
12.	Bagasse % cane (by diff.)	33.85	27.73	27.62
13.	Juice Analyses :			
	(a) Combined 1st & 2nd mill juice		Expeller Juice	
	Bx.	19.42	19.39	19.47
	Pol.	16.22	16.23	16.39
	Purity	83.52	83.70	83.67
	(b) II Mill Juice only			
	Bx.	19.54	-	-
	Pol.	15.65	-	-
	Purity	80.09	-	-
14.	Pol % bagasse	8.20	5.15	5.1
15.	Moisture % bagasse	50.10	35.70	34.95
16.	Pol % Cane	13.42	13.11	13.14
17.	Sucrose extraction (mill extraction)	79.96	89.55	89.73
18.	Fibre % Cane	13.42	13.42	13.42
19.	Crushing Capacity/hr. tonnes	4.62	2.296	2.70

Observations on the working of the Hydraulic crusher and cane juice expellers (BR-7 & BR-7A)

(1) The texture of cane fed and cell breakage:

(a) In the case of the hydraulic crusher, cutting by the sets of knives is longitudinal with long shreds of bagasse fibre whereas in the case of the expeller, the cane is cut into 3/4 to 1" pieces in transverse section.

It is therefore obvious that whereas in the case of the crusher most of the cell breakage, leading to the extraction of sugar, takes place during the preparation of cane by the knives, in the case of the expeller the cell breakage in the cut cane is small and most of the cell rupture takes place due to the tortional squeezing of the bagasse and heat generated by friction.

(b) The substantially lower moisture content of the final bagasse in the case of the expellers is due not only to better squeezing out of the juice but evaporation of moisture due to high temperature developed. The temperature of the bagasse at the exit point of the expeller was about 150°C. Actually one can see a cloud of vapour in and out at the exit point.

(2) Capacity:

Crushing capacity in the two cases was found to be as follows:

(a)	Capacity of two expellers unit (2.29 + 2.70)	4.99 t/hr
(b)	Capacity of the crusher	4.62 t/hr
(3)	Installed Power:	
(a)	6-roller crusher - 1st cutter 20HP) 2nd cutter 15HP)	Total 100 HP
	Carrier & 13" x 18" mill 75HP)	
(b)	2 Expellers Unit Cane carrier & with cutter, cutter 7.5, HP; elevator & 2 Nos. screw screw-conveyor conveyors; 3.0 HP, 2 Expellers, (75HP each); Elevator, 5HP	165.5HP

With the above installed power, the six roller unit has a capacity of 4.6 t/hr and the expellers unit has a capacity of 5.0 t/hr:

Power actually used at the expeller unit is 33HP per ton cane per hour against 24 HP per ton cane per hour of 6 roller crusher.

(4) Working:

The crushing at the expellers was smooth and continuous. The intermittent working due to choking of the cane observed in earlier designs was totally absent.

(5) Estimated sugar recovery:

The sugar in juice per cent cane in the three tests was as follows:

	Hydraulic crusher	Expeller BR-7	Expeller BR-7A
(a) Pol in juice per cent cane	10.73	11.74	11.79

Assuming Bale House Extraction as 70 percent (which is the average figure) the estimated recovery works out as follows:

(b) Recovery per cent cane	7.51	8.22	8.24
-------------------------------	------	------	------

Thus a higher recovery of the order of 0.7 percent cane, can be expected in the case of expeller crushing than with hydraulic crusher.

(6) Fuel value of expeller bagasse:

Using the following formula for NCV (Net Calorific Value)

$$\text{NCV} = 7783 - 22s - 88.27w$$

$$\text{Where } s = \text{Sugar per cent bagasse}$$

$$w = \text{Moisture per cent bagasse}$$

(a)	NCV of crusher bagasse with 8.0 per cent pol and 50 per cent moisture works out to =
	3194 BTU per lb.
(b)	NCV of expeller bagasse with 5 per cent Pol and 36 percent moisture in bagasse =
	4495 BTU per lb.

Thus the fuel value of expeller bagasse is substantially higher.

(7) Capital Cost:

(a)	Carrier, cutter, Elevator, Screw Conveyor and two Expellers complete with drives	Rs. 3,30,000.00
(b)	Carriers and two cane drives & six roller mill complete with drive	Rs. 3,30,000.00

4.2 Evolution of the Shell Furnace:

Though the juice boiling bale developed by PRAI called standard bale was faster and had higher Rab rate than the bales in use earlier, it still had the following shortcomings which all open-pan bales suffered from -

- Its inability to take wet bagasse directly from the crusher having about 52 percent moisture.
- High fuel consumption requiring extra fuel of the order of three percent on cane.
- Inversion and caramelisation losses.

Wet Bagasse Burning

The natural draft system used in the standard bale works satisfactorily with sun dried bagasse (not more than 10 per cent moisture). If wet bagasse is fed, the combustion zone gets extinguished. Since drying the bagasse in the sun is cumbersome (requiring

4-5 acres of open land and 25-30 unskilled workers per day) the bagasse must be dried in the furnace which could be achieved with a stop-grate design or hearth (horse-shoe) design as in vacuum-pan factories. These step grate designs were tried, see Figs. 6, 6A and 6B.

Fig. 6 STEPGRATE FURNACE

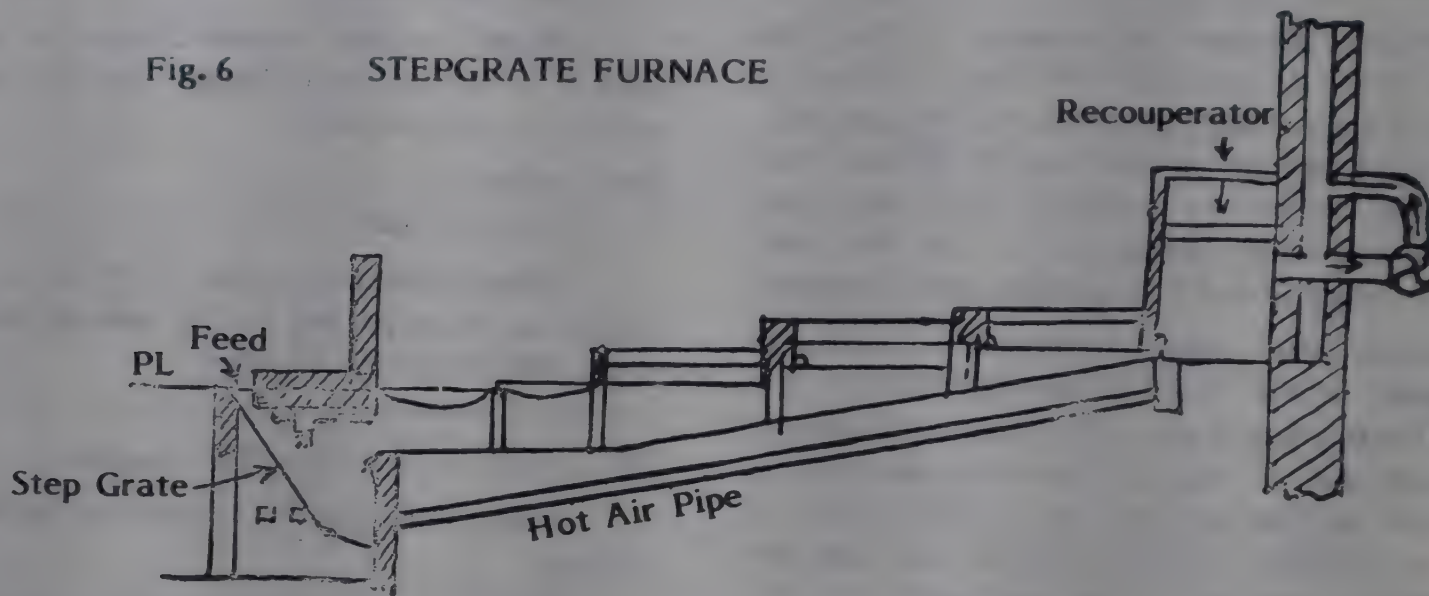


Fig. 6 A STEPGRATE WITH ARCH

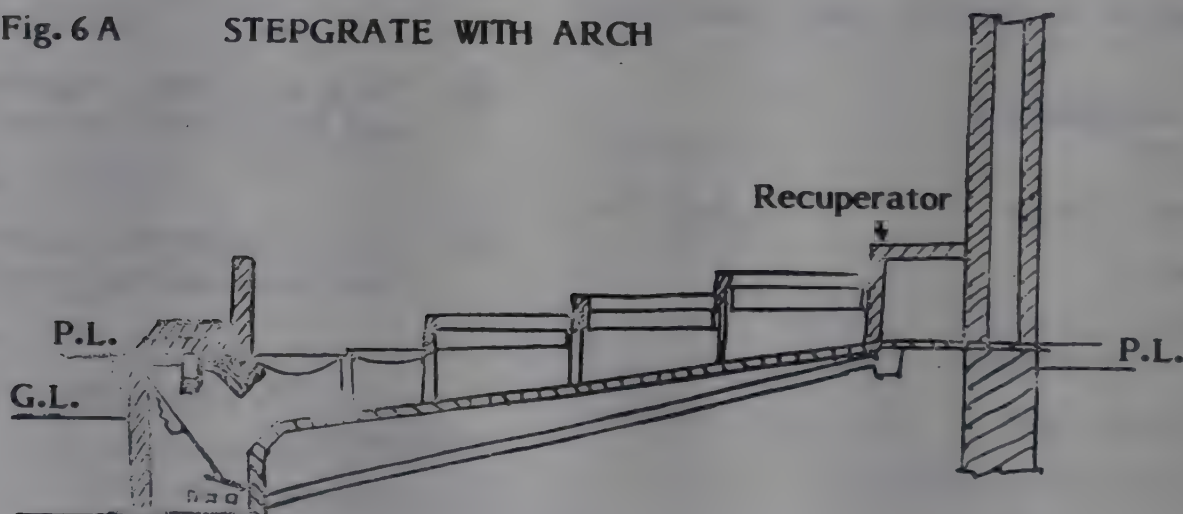
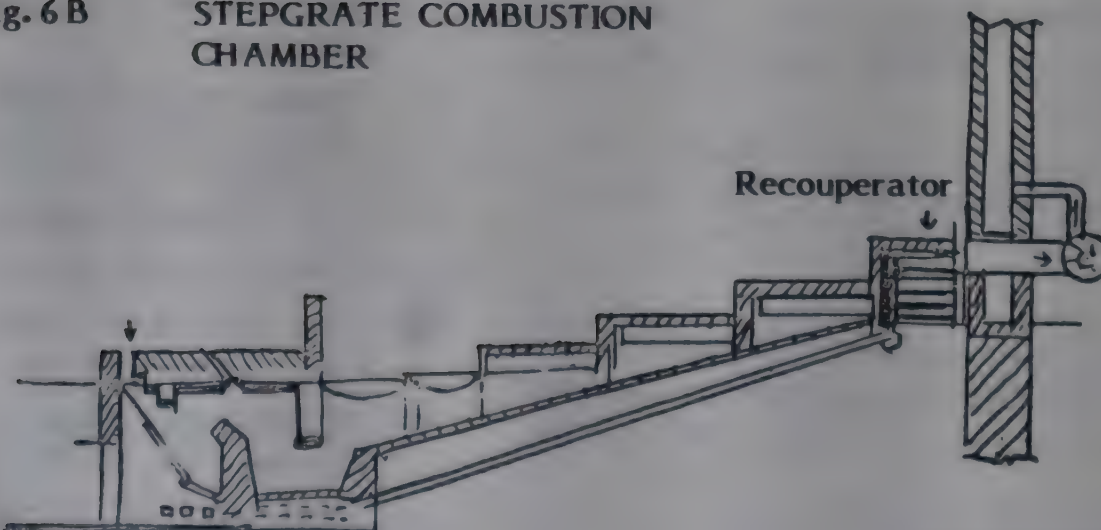


Fig. 6 B STEPGRATE COMBUSTION CHAMBER



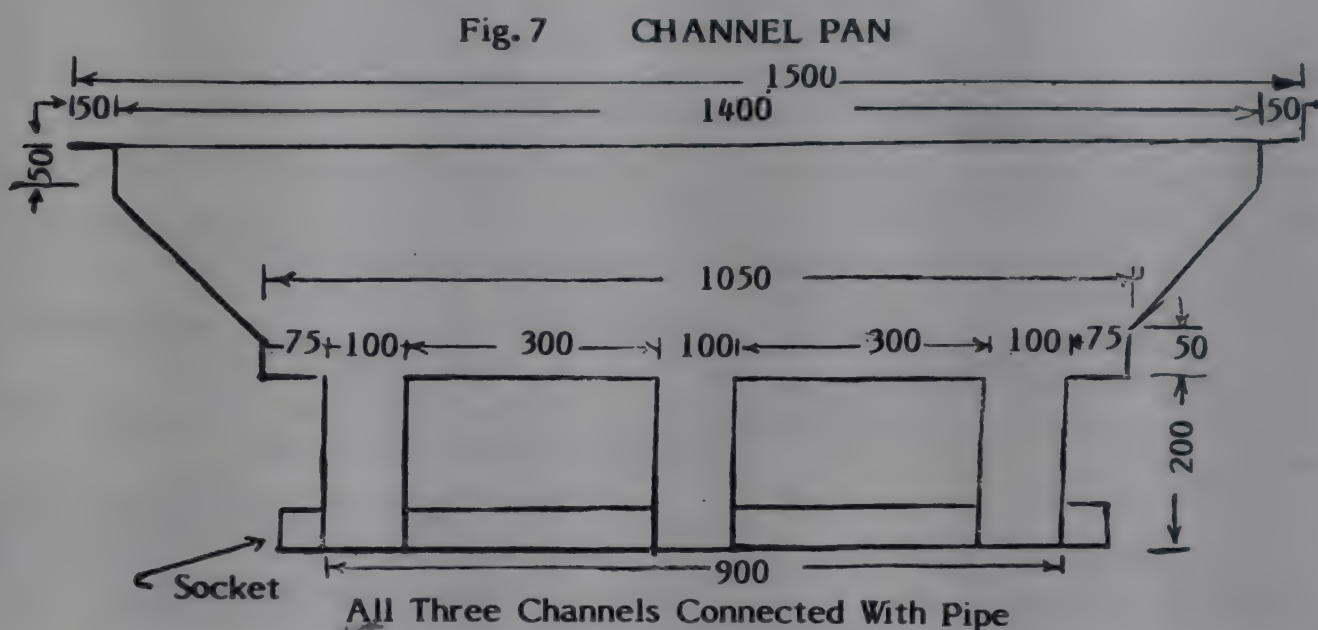
The design of Fig. 6 could not take fully wet bagasse. In design 6A an arch was provided. This proved to be more effective boiling capacity and fuel efficiency were still low. In view of the long bagasse flame, a combustion chamber was added, Fig. 6B. This increased the draft requirement, so an induced draft fan was fitted after the recuperator. This furnace gave much better combustion performance but the boiling rate and fuel consumption were still unsatisfactory, despite replacement of two round pans with three rectangular pans.

A hearth furnace was also designed but this too did not give the desired results.

Change in Pan Design

It was incidentally observed that the inversion

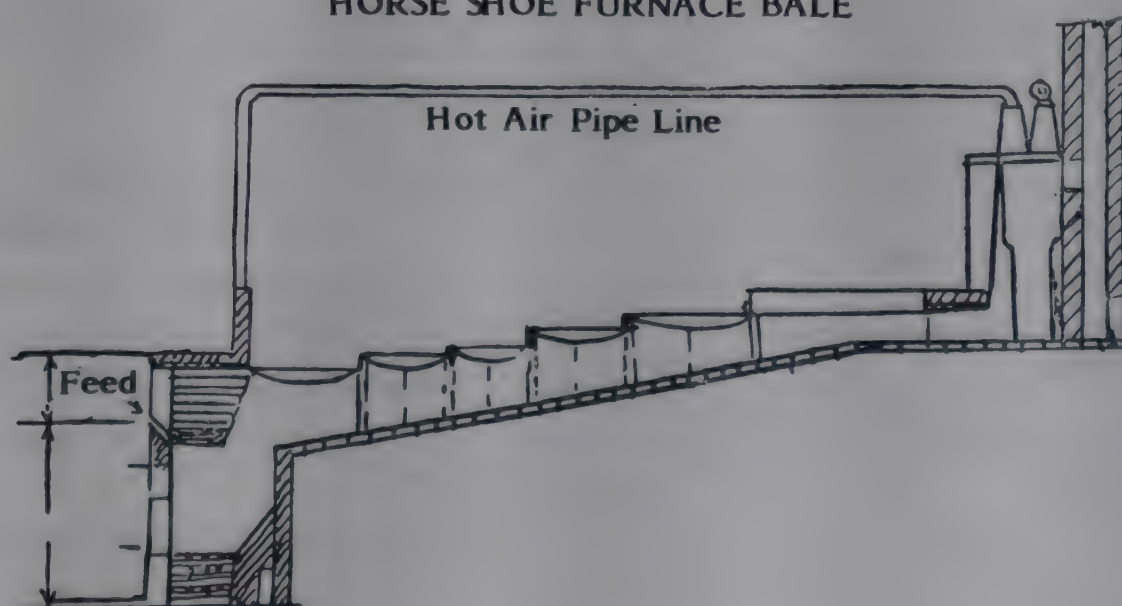
and caramelisation are lower in the step grate or hearth type wet bagasse furnace though the boiling rate was lower as compared to furnaces in which sun dried bagasse is burnt, because of lower furnace temperatures. An attempt was therefore made to improve juice boiling rate by effecting better heat absorption by the pans. This could be done by increasing the juice volume-heating surface ratio. The first two pans receive heat largely by radiation but in later pans (Nos. 3, 4 & 5) the heat transfer is mostly by convection. So the design of pan numbers 3, 4 and 5 was changed. Instead of the round bottom pans, rectangular pans with channels, were provided. The channel design is shown in Fig. 7 below :



Introduction of these channel pans helped to improve the juice boiling capacity. Simultaneously, efforts were made to improve the wet bagasse furnace design. The step grate furnace with a separate combustion chamber had given fairly good results in regard

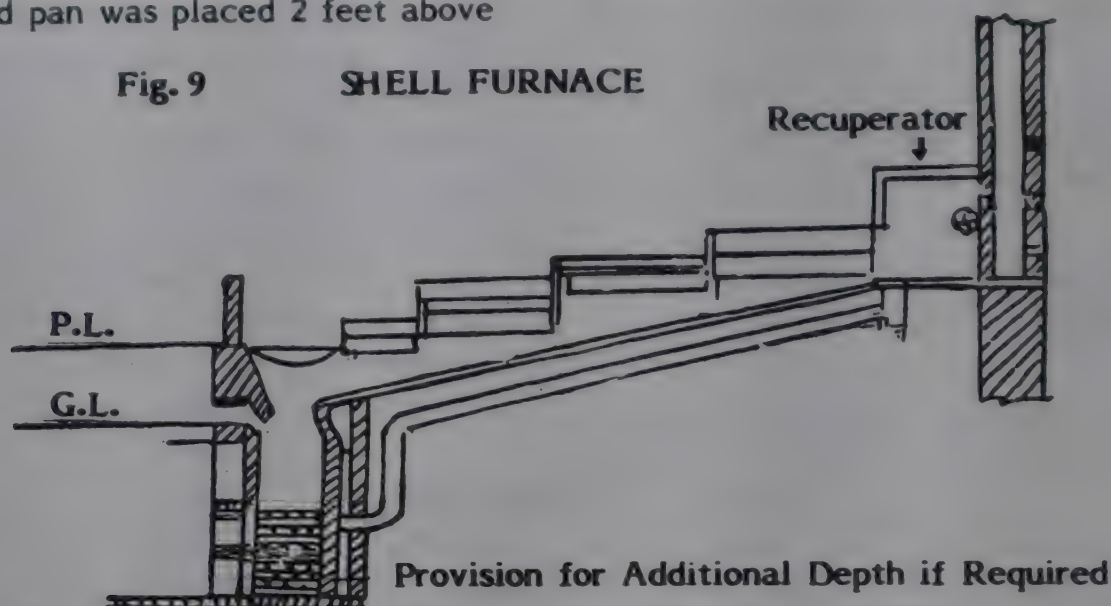
to burning the wet bagasse but the construction of a separate chamber led to additional cost. In order to simplify the design a modified type of hearth furnace was developed. Fig. 8 shows the hearth furnace bale.

**Fig. 8
HORSE SHOE FURNACE BALE**



This design was modified. The hearth portion was made circular of 3 feet dia in place of horse shoe shape as is done in the Ward furnace. The top portion of the hearth was partly covered by an overhanging arch leaving only a 20 inches dia opening for the exit of gases. The first round pan was placed 2 feet above

the mouth of the hearth. Preheated air at a temperature of 100° - 120°C was provided by the recuperator to the tuyers of the hearth. Ash was removed through a door at the tuyer level. This furnace has been named as 'Shell Furnace' and is shown in Fig. 9.



In this furnace bagasse is fed through a hole at the constriction and it dries as it falls to the hearth floor, with smaller particles burning in suspension and larger pieces burning on the hearth. Provision has been made for hot secondary air at the constriction. In this, the third pan is 6 feet long with two inch wide and 18 inch deep channels. The fourth pan is similar but has 12 inch deep channels.

Test Results

Comparative test results of the Shell Furnace Bale and Standard Bale are given below :

	Shell (S 2 R)	Standard
1. Juice brix	20.7	22.1
2. Rab brix	83.5	86.1
3. Juice boiled, kg/hr	762.4	623.0
4. Rab rate, kg/hr	189.0	160.0
5. Water evaporated, kg/hr	523.4	463.0
6. Bagasse burnt, kg/hr	400.00	195.0
7. Bagasse moisture percent	48.0	6.0
8. G.C.V. of bagasse K. Cal	2392.0	4324.0
9. Water evaporation efficiency*	34.9	32.0
10. Clear juice temperature °C	68.0	68.0

*Heat utilised for evaporation per cent heat supplied (GCV)

The shell furnace bale is operated in exactly the same manner as the standard bale and no alteration in working practice is necessary.

The addition of the air pre-heater and forced draft fan approximately doubles the price of the furnace from about Rs. 15,000 to Rs. 30,000 but it is possible to operate with only five numbers of furnaces in

place of seven because bale cleaning duties are reduced.

Far outweighing the costs of the furnace are two major benefits viz.

- (a) Extra fuel (3 tonnes/day for 100 tcd plant) is not required.
- (b) Bagasse does not require drying, saving labour wages of 25 workers/day.

These two items amount to roughly 5 percent of the processing cost of an OPS factory and as such the reduction on processing cost is quite substantial.

5. Conclusion

These two major advances in OPS technology viz. :

- (i) Successful working of the cane juice Expeller in place of six roller mill and (ii) Evolution of Shell Furnace for wet bagasse burning, should be able to increase the sugar recovery level by a further 0.8 to 0.9 per cent in cane i.e. if the conventional average recovery is taken as 7.5% it should be possible to obtain a recovery now of 8.3 per cent.

6. Acknowledgement

Grateful acknowledgement is made of the facilities provided for R & D work by,

- (i) Planning Research & Action Department of U. P. Government, Lucknow.
- (ii) Council of Science & Technology, U.P. Lucknow.
- (iii) Bhatia Coop. Farm, Jugroonagar, (Dist. Bareilly), U. P.
- (iv) Gandhi Smarak Nidhi Research Unit, Shardapuri, U. P.
- (v) Intermediate Technology Industrial Services, Rugby, England.

BY-PRODUCTS OF THE SUGARCANE INDUSTRY - A SYNOPSIS

M.S. Naik

Processing of sugarcane is an Agro-Industry which is a very valuable contributor of elements of food and energy. It constituted a direct source of food in sugar and its by-products are vast potential reserves for human and animal consumption. Besides this the Sugar Industry's by-products are capable of providing energy as a renewable source. Sugarcane is one of the most notable and efficient crops the World has

known in terms of using and transforming Solar Energy, the eternal wonder of the scheme of our universe.

Processing of Sugarcane in a factory will yield sugar as well as the by-products : bagasse, molasses and filter-mud. The cane tops obtained prior to that while harvesting sugarcane are themselves a valuable by-product. The total idea of these by-products can be represented under, as in Table 1 and Table 2.

Table 1
BY - PRODUCTS OBTAINED DURING PROCESSING OF
SUGARCANE TO SUGAR

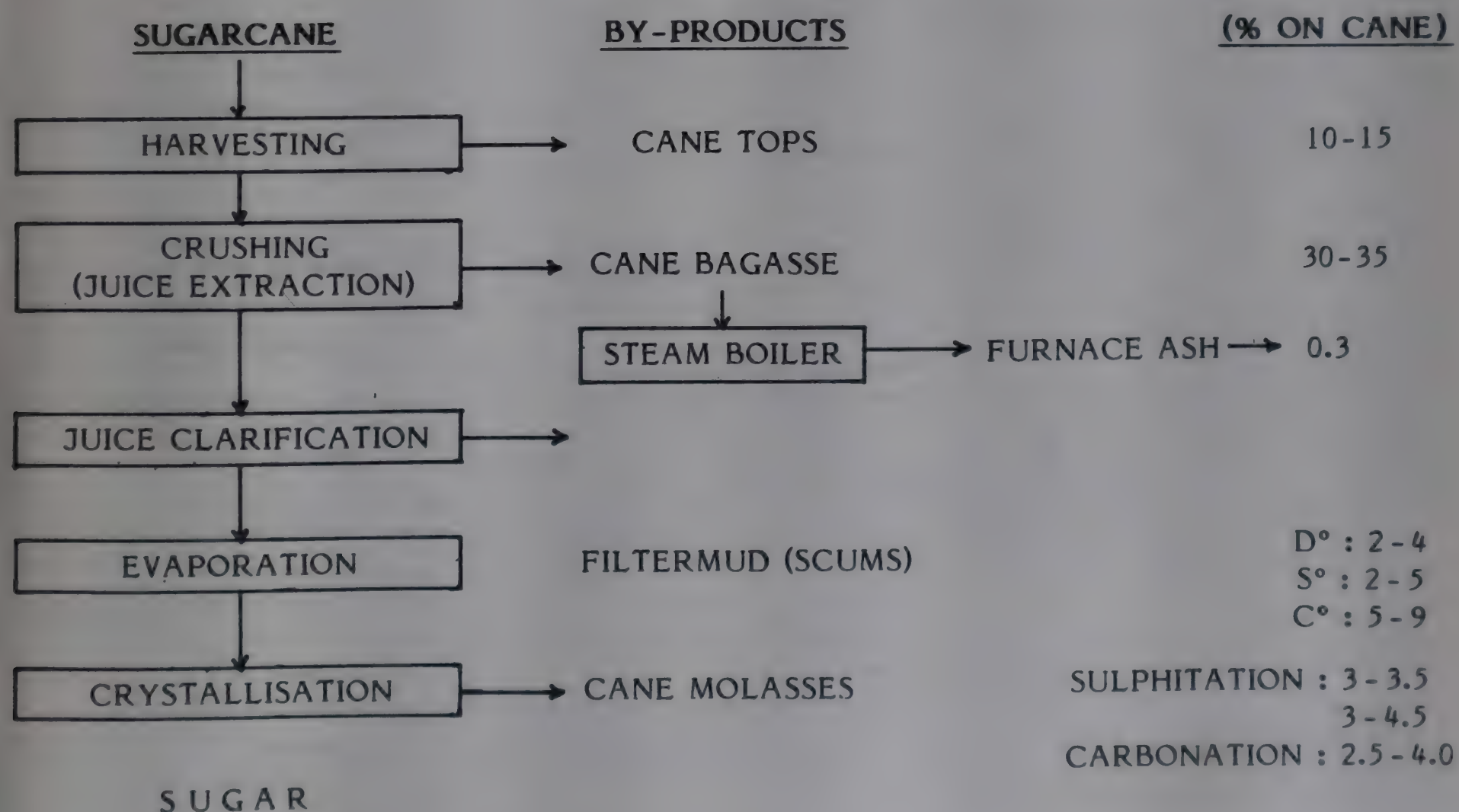
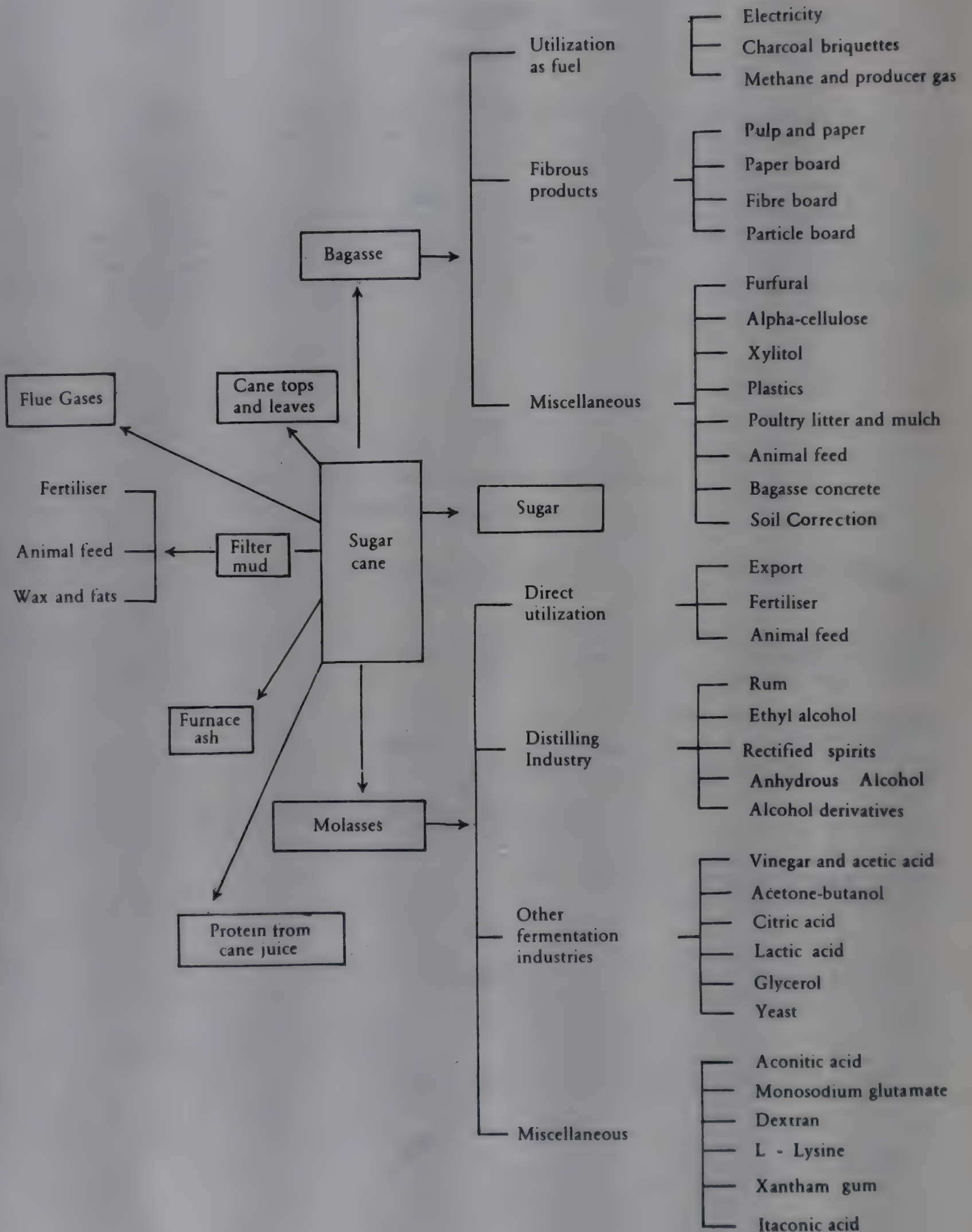


Table 2



Proper and efficient processing of these by-products to higher value products, can be of benefit to the economy of the sugar industry in broad sense, since the revenue of the industry will not be that of sugar only, but also including that of the processed by-products. Added value obtained from the processing of these by-products to higher value products can give an additional revenue to the sugar industry and can cut down sugar production cost and risk. A good example is Taiwan Sugar Corporation. In 1981 its sales revenue from by-products amounts to about 40% of its total revenue. Fig. 4 shows the estimated added value that can be obtained from processing of molasses not integrated with the sugar factory compared to its sales revenue as such amounting Rp. 34,000/ton.

In general, cane tops, fresh or preserved, can be used as cattle forage, and bagasse used as fuel for the steam boiler in the sugar factory or as raw material for pulp, paper and fibre board. Molasses can be used as a raw material for the fermentation industries or directly utilized for cattle feed. Examples of products from molasses fermentation are ethanol, rum, lactic acid and glutamic acid (for mono-sodium-glutamate production).

More sophisticated treatments such as membrane filtration, electrodialysis, ion exchange processes and chromatography can convert the molasses into purer sugar solutions, suitable to be utilized as liquid sugar or feed stock for those fermentation industries requiring purer sugar solutions than molasses, such as citric acid, antibiotics, etc.

For product diversification, the sugar or cane juice can be used as feed stock for the fermentation and chemical industries, giving the possibilities as shown in Fig. 5.

As an effort to overcome the difficulties faced by the sugar industry, some feasibility studies were done on the processing of sugar cane by-products as a step towards product diversification of the sugar industry to decrease sugar production risk.

The benefit of by-product processing will be even greater when the by-product factories are built, adjacent to and operated integrally with the sugar factories. Additional benefits can be obtained from :

- saving in transport cost
- common use of steam boiler, electric power generator, process water supply, workshop, material and spare parts supply, etc., resulting in lower operation and management cost.
- surplus of energy gained by energy optimization in the sugar factory, such as bagasse and trash as fuel, could be used for developing of by-products utilization.

From the energy aspects, many possibilities could be done in order to improve the efficiency in the existing sugar factories, such as :

The generation of steams; increasing the efficiency of the generators in existing equipment, minimal necessary measurement elements, use of recovery surfaces for heating the air and water, drying the bagasse by using flue gasses, the use of more efficient systems of feeding the bagasse into the furnace, modern methods of pneumatic transportation, automatic systems for the use of high quality condensates, the application of modern technologies for treating the feed water, the use of control links for automated operation, the development of steam generators.

The use of steam : increasing the efficiency of the equipment now used in the technological process, the use of chemical products to increase the operational efficiency of the heaters, evaporators and pans, the introduction of very efficient evaporators, the use of thermocompressors or turbo-compressors in the evaporation system, the use of control links for the automated operation of thermotechnological equipment, the development of thermotechnical equipment.

The high humidity of the bagasse when it comes out of the tandems, have led us to think of using the alternative of drying the bagasse with chimney gass as a means of recovering energy. It is estimated that savings of up to 15 percent in bagasse may be obtained by using this method. An example could be seen in Fig. 6.

Rearrangement of evaporation system will improve the energy balance.

Theoretically, there are many possibilities for the industrial utilization of by-products. But, in fact it could not be developed or equally applicable at the same time. Therefore the program of diversification depends on the characteristics and conditions of the region. Aspects related to problems involved in the industrial use of by products must be studied in order to select the best alternatives.

The most important of these problems are :

- market
- existing industrial base
- economic profitability
- research and development.

Many factors are affecting the economic profitability of the by-products. These include the cost of equipment or other supporting facilities, the fluctuations of price of raw materials (molasses) as well as chemicals. In periods when the price of molasses is rising and the cost of by-products is based on this price, it is not possible to obtain profit, and the project

Fig.4
POSSIBLE INCOME FROM SALES OF
MOLASSES AND PROFIT FROM MOLASSES
PROCESSING INTO VARIOUS PRODUCTS

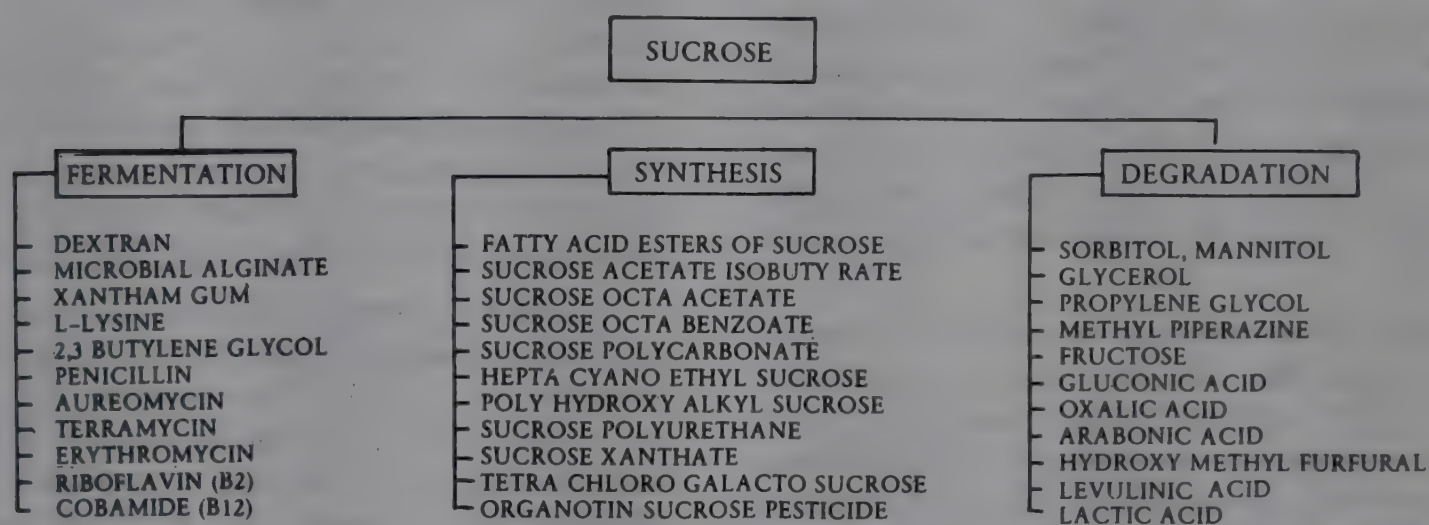
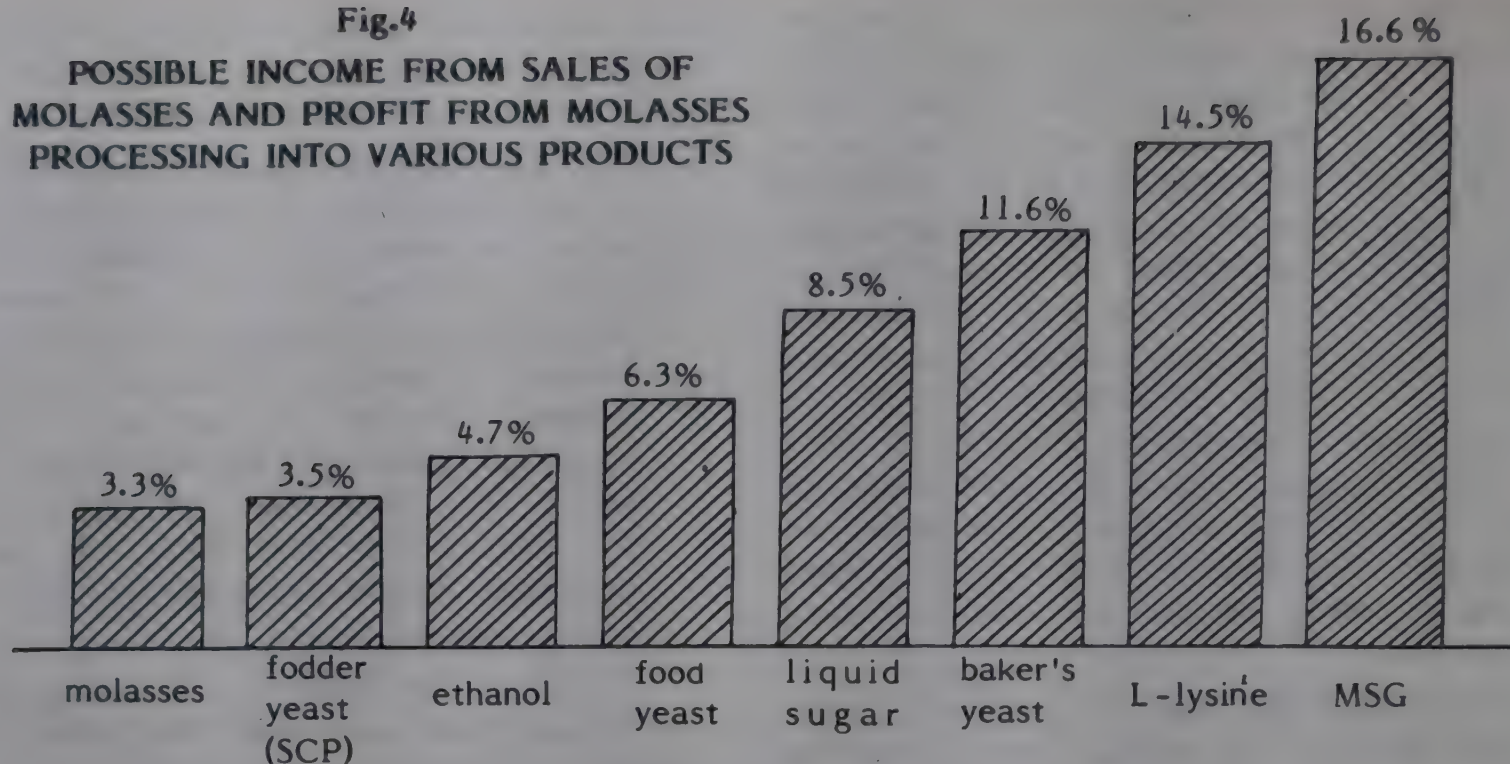


Fig. 5
Products of sucrose of actual or
potential importance

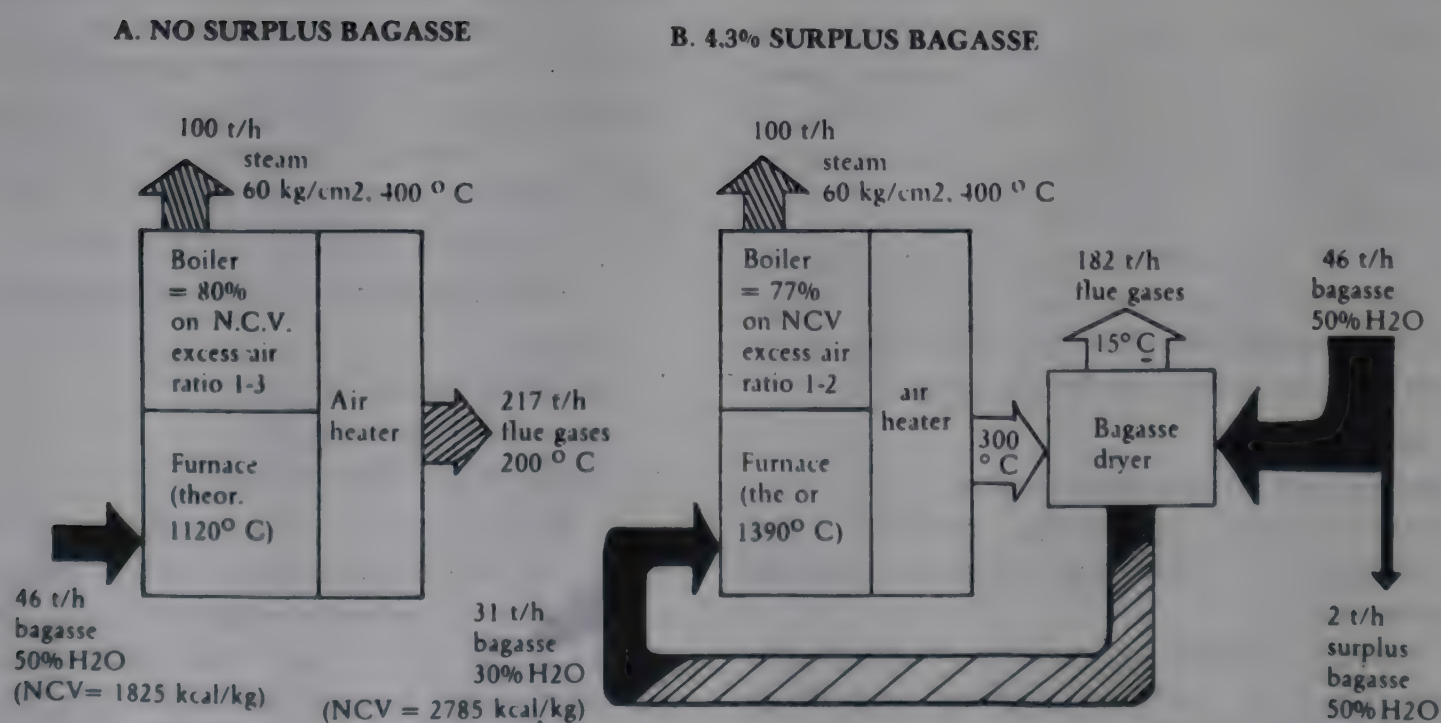


Fig. 6 Bagasse drying leads to some fuel economy

is not feasible. In this case it is hard to decide whether to sell the molasses at high price or to produce certain products.

Thus viewed :

- Sugarcane offers tremendous possibilities for the industrial use of by-products with which to solve some of the problems such as meeting the demand for pulp, paper, fiber-board, providing animal feed and food stuffs for human consumption, meeting energy needs and developing chemical industry.
- An integration between sugar plant with one or more by-products factories, combined under the same management (industrial complexes) would bring about substantial savings and should prove very beneficial to the sugar industry.
- In the development of the utilization of by-products, priority must be given to the steam balances optimisation in the sugar factory in order to obtain surplus bagasse to supply energy.
- The diversification of sugar industry by utilizing of sugarcane by-products will make it possible to reduce the sugar production risk or cost besides improvement of productivity in the field and reduction of sugar losses in the factory.
- As an illustration, a Sugar Factory in Indonesia, in 1984, crushed 2,75,817 t cane.
- Molasses produced : 3.8% cane = 9102 t.
- Due to energy efficiency, especially in the evaporation system (quintuple effect), excess bagasse obtained : 17436 t with calorific value of 1954 kcal/kg equal to 3407×10^7 kcal. If the boiler efficiency = 0.78, the calorific value of steam obtained = 26575.10^6 kcal. For producing 1 t of SCP the energy needed 6764783.8 kcal equal to 676.5 kg fuel oil. Molasses can be processed into SCP =
$$\frac{4 \times 3407.10^7 \text{ t}}{6764.8.10^3} = 20145 \text{ t molasses.}$$
 SCP produced = 5036.25 t.

Note :

Energy consumption for producing 1 t SCP.

1. Molasses treatment		
Electric power = 13.5 kwh/t	11608, 7 kcal	
steam = 899 kg	600352, 2 kcal	
2. Auxiliary preparation		
Electric power = 9 kwh/t	7739, 1 kcal	
Steam = 11.2 kg/t	7479, 4 kcal	
3. SCP processing (excl. spray drying)		
Electric power = 941.2 kwh/t	809338 kcal	
Steam = 2588 kg/t	1728266, 4 kcal	
4. Spray drying		
Fuel oil 360 kg.	3600000 kcal	
Total energy consumed	6764783, 8 kcal/t SCP	

SUGAR AND BY-PRODUCTS OBTAINED FROM 100 TONNES CANE CRUSHED IN A TYPICAL SUGAR FACTORY (1984)

(A Case Study)

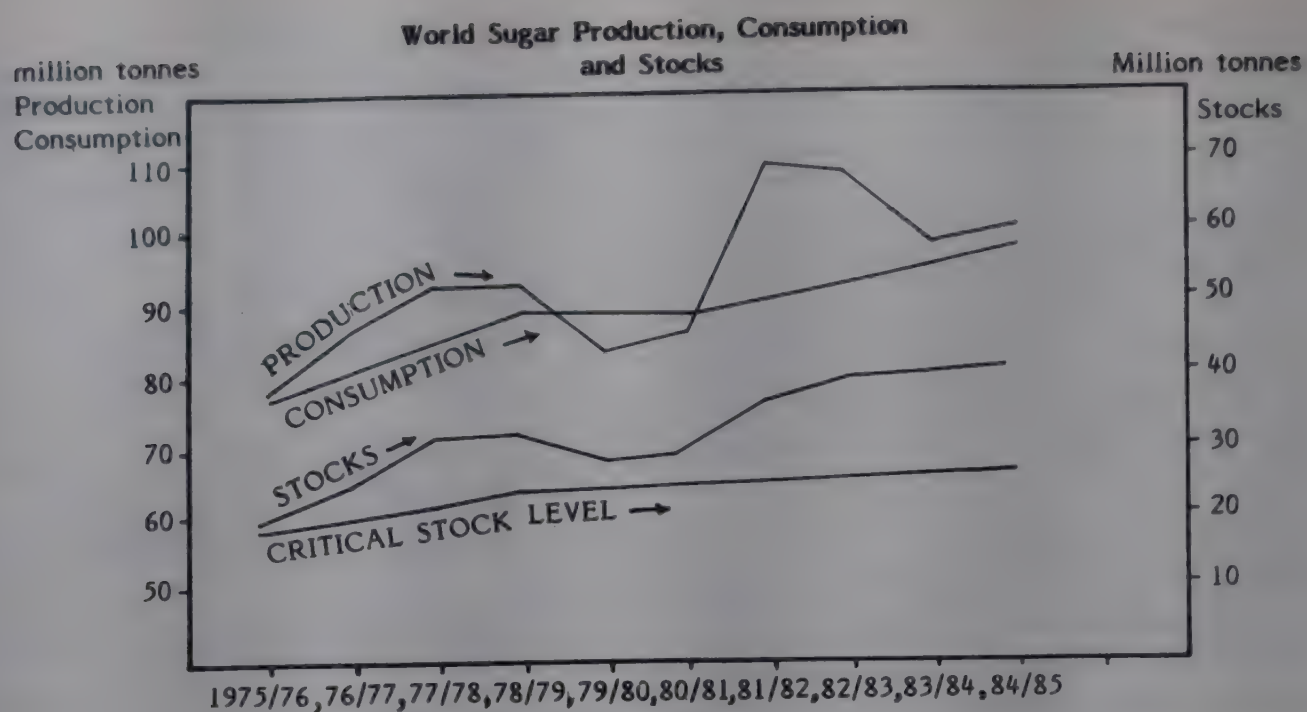
Sugar / By-product	Amount (t)
Plantation white sugar (SHS IA)	9.29
Molasses (89.1 Bx)	3.3
Filtermud (Carbonation)	7.9
Surplus bagasse (at 47.2% moisture)	6.3

Conditions :

- Sucrose % cane	11.09
- Fibre % cane	4.7
- Overall recovery (9%)	9.29
- Steam consumption (kg/t cane)	5.20
Boiler efficiency (gross) (%)	60

Alcohol from sugar in West Germany

A company has been founded by the farmer-owned sugar industry in Lower Saxony for the planning and construction of a plant to produce some 250,000 hl of alcohol per year for fuel from about 40,000 tonnes of sugar. It is to start operations in 1988 and will be annexed to the Gross-Munzel sugar factory.



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introduced in the year 1985-86. Against the effective statutory minimum cane price of Rs.20/- per quintal, it was assumed that the actual cane price is to be paid by the industry would be about Rs.24/-. Hence a retail price of Rs.7/- per Kg. of sugar was considered reasonable. There is also an increased realisation amongst the Govt. circles that the twin objectives of prompt regular payment of an economic price for cane and restricting the price increase in sugar to the minimum possible level, can be attained only by modifications of the ratio of levy and free sale sugar from 60:40 to 50:50. However, these twin goals can best be attained by fixing the ratio of levy and free sale sugar at 40:60 rather than at 50:50 as at present.

18. Co-ordinated Price Policy :

In order to stabilise the market it is not only necessary to maintain a reasonable ratio between levy and free sale sugar but also to co-ordinate the prices of sugarcane and sugar on the one hand and the prices of sugar, gur and Khandsari on the other. At present gur prices are not at all regulated and Khandsari prices are at an unusually high level. It is necessary to regulate and coordinate all these prices in a systematic manner.

19. Buffer Stocks :

In order to ensure efficient and effective regulation

of the market it is necessary to regulate the monthly releases of sugar and maintain a buffer stock to effectively enforce the release orders. The need for the buffer stocks have been variously estimated. We find the estimates made by the eminent Sugar Technologist, M. Anand to be most reasonable and pragmatic. Mr Anand has suggested a buffer of 11 lakh M. tonnes of sugar. Of this 7 lakh tonnes would be utilised for stabilising Exports; another 5 lakh tonnes to support open-market operations within India to stabilise domestic sugar prices and buffer stock of one lakh tonnes to meet any unforeseen local emergency. It is estimated on the basis of the past experience of the operation of buffer stocks that the cost of maintaining buffer stocks etc. works out to Rs.39 crores per annum for a stock of 5 lakh M. tonnes of sugar.

20 Regulation Of Monthly .

Releases :

Monthly releases are an important device for regulating the supply of sugar to the domestic market. So far no rational basis has been formulated for regulating these releases. It is suggested that releases based on the observed patterns of market consumption in the immediate past may be helpful in stabilising both prices and consumption.

Table - 14

INDEX NUMBER OF WHOLESALE PRICES

BASE : 1970-71 = 100

COMMODITY	FINANCIAL YEAR												%		
	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86		
														(Upto	Increase
														Dec.)	in
															1985-86
															over 1973 - 74
Sugar	150	167	169	173	159	147	177	250	259	229	231	244	285	90	
Sugar Cane	117	123	128	129	126	150	189	194	193	191	196	212	253	116	
Gur	202	206	233	238	198	148	260	437	371	275	341	384	457	126	
Khandsari	144	236	234	227	187	135	208	385	356	251	258	286	363	152	
Rice	140	183	179	157	162	161	184	204	226	257	292	273	287	105	
Wheat	107	183	160	152	157	154	161	176	192	214	218	210	220	106	
Vanaspati	140	185	160	148	168	163	196	211	235	258	255	275	292	109	
Vegetables &															
Fruits	145	160	139	148	177	161	191	213	243	250	301	304	360	148	
Pulses	177	216	182	146	215	247	244	323	339	302	347	431	460	160	
All															
commodities :	140	175	173	177	186	186	218	257	281	289	316	338	358	156	

(SOURCE: MONTHLY BULLETIN ON INDEX NOS. OF WHOLESALE PRICES IN INDIA)

NOTE: The price indices for sugarcane have been worked out on the basis of cane price fixed by Government.

Table - 15

STATEMENT SHOWING COST OF PRODUCTION AND EX - FACTORY SELLING PRICE OF SUGAR FOR THE YEARS 1978-79, 1980-81, 1981-82 & 1982-83

(Rs. per quintal)											
S. No.	Name of Zone	1978-79					1979-80				
		Cane Cost*	Purchase Tax/ Cess Driage	Conversion Cost	Return (inclu- ding interest on long-term borrowings)	Economic cost/ cost of pro- duction for totality of production	Cane Cost*	Purchase Tax/ cess driage	Conversion cost	Return (including interest on long-term borrowings)	Economic cost/ cost of pro- duction for totality of production
1.	Punjab	117.37	3.10	62.12	25.13	207.72	156.25	3.17	73.50	23.18	256.10
2.	Haryana	117.63	18.54	62.23	25.13	223.53	148.17	18.57	69.82	23.18	259.74
3.	Rajasthan	119.94	0.20	90.23	25.13	235.50	150.28	0.26	106.86	23.18	280.58
4.	West U. P.	118.61	15.80	57.15	25.13	216.69	147.53	15.90	75.11	23.18	261.72
5.	Central U. P.	126.91	16.83	54.47	25.13	223.34	146.23	16.38	76.26	23.18	262.05
6.	East U. P.	125.05	16.80	71.60	25.13	238.58	147.35	16.35	100.59	23.18	278.47
7.	North Bihar	124.58	13.51	78.50	25.13	241.72	146.36	13.30	95.30	23.18	278.14
8.	South Bihar	120.01	13.87	118.86	25.13	277.87	144.84	13.50	124.67	23.18	306.19
9.	Gujarat	123.98	10.60	54.19	25.13	213.90	147.72	12.99	60.80	23.18	244.69
10.	Mdhaya Pradesh	120.97	5.90	80.42	25.13	232.42	147.18	6.98	97.11	23.18	274.45
11.	Maharashtra	119.35	15.16	49.22	25.13	208.86	148.33	14.96	57.95	23.18	244.42
12.	Karnataka	12.161	17.71	59.74	25.13	224.19	150.30	18.57	66.44	23.18	258.49
13.	Andhra Pradesh	119.57	11.03	68.64	25.13	224.37	147.45	10.91	70.69	23.18	252.23
14.	Tamil Nadu & Pondicherry	127.53	21.91	54.39	25.13	228.96	152.27	24.94	64.31	23.18	264.70
15.	Assam, Orissa, West Bengal and Nagaland	121.65	1.95	87.29	25.13	236.02	147.93	0.42	93.88	23.18	265.41
16.	Kerala & Goa	122.67	5.60	76.39	25.13	229.79	156.01	7.03	75.62	23.18	261.84
All India average						219.63	255.94				

*Cost of cane has been calculated on the basis of the minimum statutory cane price fixed by the Govt.

(Continued)

(Contd. Table - 15)

SL No.	Name of Zone	(Rs. per quintal)											
		1980-81						1981-82					
		Cane price (including driage)	Cost Purchase Tax/coop. Societies Commission	Conversion Cost	Return	@Total ex-factory price as notified	Recovery % age	Duration (Days)	Cane price (Including driage)	Cost Purchase tax/coop. Society Commission	Conversion Cost	Return	Total ex-factory price as notified @
1.	Punjab	155.49	2.84	129.22	30.97	318.52	9.26	128	145.46	3.06	123.73	31.27	303.52
2.	Haryana	156.49	17.15	104.99	30.97	309.60	8.50	145	157.76	18.66	109.16	31.27	316.85
3.	Rajasthan	150.60	—	131.25	30.97	312.82	9.24	81	157.39	—	143.60	31.27	332.26
4.	West U. P.	161.32	14.84	75.53	30.97	282.66	9.70	146	154.34	14.95	75.44	31.27	276.00
5.	Central U. P.	158.78	15.07	90.38	30.97	295.20	9.60	158	156.63	15.10	86.96	31.27	289.96
6.	East U. P.	155.10	15.66	115.38	30.97	317.11	9.34	101	154.39	15.52	111.63	31.27	312.81
7.	North Bihar	156.53	12.37	123.80	30.97	323.67	9.09	111	157.96	12.65	113.55	31.27	315.43
8.	South Bihar	153.66	13.29	147.83	30.97	345.75	8.50	75	153.79	13.53	164.87	31.27	363.46
9.	Gujarat	156.58	13.78	70.33	30.97	271.66	9.82	160	158.95	13.99	79.54	31.27	283.75
10.	Madhya Pradesh	149.53	6.11	158.36	30.97	344.97	8.89	84	153.35	6.20	172.94	31.27	363.76
11.	Maharashtra	147.98	15.27	76.81	30.97	271.03	10.89	160	153.89	15.24	81.39	31.27	281.79
12.	Karnataka	152.22	19.10	77.73	30.97	280.02	10.09	148	156.85	18.63	74.67	31.27	281.42
13.	Andhra Pradesh	149.70	11.00	96.45	30.97	288.12	9.18	125	152.76	17.43	92.39	31.27	293.85
14.	Tamil Nadu & Pandicherry	160.35	25.80	80.87	30.97	297.99	8.65	160	159.78	25.92	85.93	31.27	302.90
15.	Assam, Orissa, West Bengal & Nagaland	155.33	—	134.97	30.97	321.27	8.50	113	158.20	—	123.65	31.27	313.12
16.	Kerala & Goa	150.37	5.76	87.57	30.97	274.67	8.60	106	158.19	7.37	103.31	31.27	300.14
All India average						284.56							289.56

(Contd. Table - 15)

						(Rs. per quintal)
Sl.No.	ZONE	1982-83		Conversion cost	Return	Total ex-factory price as notified ^a
		Cane price (including driage)	CANE COST Purchase Tax/ Cane Cess/Coop. Soc. Commission			
1.	Punjab	160.89	2.69	109.16	31.27	304.01
2.	Haryana	154.61	18.12	106.16	31.27	310.16
3.	Rajasthan	156.54	—	160.70	31.27	348.51
4.	West U.P.	155.19	15.01	75.94	31.27	277.41
5.	Central U.P.	161.55	15.85	96.48	31.27	305.15
6.	East U.P.	158.42	15.76	100.53	31.27	305.98
7.	North Bihar	156.53	12.42	107.73	31.27	307.95
8.	South Bihar	153.31	13.53	165.73	31.27	363.84
9.	Gujarat	161.78	14.23	82.66	31.27	289.94
10.	Madhya Pradesh	155.89	6.26	163.16	31.27	356.58
11.	Maharashtra	153.37	15.26	84.26	31.27	284.16
12.	Karnataka	157.61	18.27	73.71	31.27	280.86
13.	Andhra Pradesh	160.18	18.10	93.16	31.27	302.71
14.	Tamil Nadu and Pondicherry	164.05	26.26	86.96	31.27	308.54
15.	Assam, Orissa, West Bengal and Nagaland	156.70	—	145.62	31.27	333.59
16.	Kerala & Goa	155.39	6.42	123.95	31.27	317.03
ALL INDIA		157.24	16.01	89.21	31.27	293.73

^a In the case of weaker units included in schedule VI of the price notification, an additional Rs. 26 per quintal has been allowed in the prices.

Source : Lok Sabha question nos. 3215 dt. 7.7.80, 9589 dt. 4.5.81 & 1042 dt. 24.8.81, 4684, dt. 21.12.81 210 dt. 7.12.81 & 3234 dt. 12-12-83.

★★★

NATIONAL BANK FOR AGRICULTURE AND RURAL DEVELOPMENT

Sterling Centre, Dr. Annie Besant Road,
Worli, BOMBAY 400 018

Introduction

A committee to Review Arrangement for Institutional Credit for Agriculture and Rural Development (CRAFICARD) set up by the Reserve Bank of India recommended in its Interim Report submitted to the Reserve Bank in November 1979, the setting up of a national level institution to be called the National Bank for Agriculture and Rural Development (NABARD) for providing all types of production and investment credit for agriculture and rural development and also to act as the agency for promoting integrated rural development. CRAFICARD also gave, in its Interim Report, the broad framework of the functional role and responsibilities of NABARD. Subsequently this recommendation of CRAFICARD was accepted by Government of India and Reserve Bank of India and a bill for setting up NABARD was passed and NABARD came into being.

Concept of NABARD

National Bank for Agriculture and Rural Development has been established as an Apex Institution,

(i) for providing investment credit for the promotion of agriculture, small-scale industries, cottage and village industries, handicrafts and other allied economic activities in rural areas with the object of ensuring integrated rural development and securing prosperity of rural areas, and for matters connected therewith or incidental thereto.

(ii) To take measures towards institution building for improving the capacity of the credit delivery system to provide credit and

(iii) coordinate the rural financing activities of all the institutions interested in developmental work at the field level.

As regards purveying of credit, NABARD will be the principal financial institution providing short-term, medium-term and long-term credit to the institutional agencies purveying rural credit.

With reference to NABARD, RBI will have the responsibility of spawning, fostering and nurturing the new institution. In its new role pertaining to matters

of agriculture and rural development, RBI will guide and assist NABARD.

Highlights

Highlights of efforts made by this National Bank during the year, towards achieving these goals are summarised below.

Short-term credit limits sanctioned to state co-operative banks (SCBs) for seasonal agricultural operations (Crop loans) increased in absolute terms to Rs.1,309 crores from Rs.1,233 crores last year. The limits were utilised to the extent of 66.7 per cent during the year as against 70.4 per cent in the previous year.

Special measures were introduced to improve credit flow for production of oilseeds and pulses. A separate line of short-term credit to SCBs finance cultivators of oilseeds has been opened.

Refinance disbursed for investment credit during the year was Rs.1,192 crores recording an increase of 12.3 per cent over the previous year.

Limits sanctioned for financing marketing of crops aggregated Rs.40 crores as against Rs.27 crores in the previous year.

To meet the credit needs of SCBs for procurement, stocking and wholesale distribution of chemical fertilisers, credit limits aggregating Rs.29 crores were sanctioned for the calendar year 1985. Maximum outstandings against these limits stood at Rs.24 crores in 1985 compared with Rs.16 crores in the previous year.

A sum of Rs.385 crores provided for minor irrigation to increase production of crops.

For development of wastelands, steps have been initiated to provide refinance for raising private nurseries and bankable forestry schemes through the efforts of individual farmers and corporate bodies.

To meet the growing investment credit needs of the agricultural sector, NABARD Credit Project-I

was successfully negotiated for a total financial assistance of US \$ 375 million from the World Bank. The project came into effect from 28 May, 1986.

For diversification of the rural economy and expansion of non-agricultural activities, refinance support was extended for working capital finance, long-term investments and financing of infrastructural activities in the rural sector. Suitable policy measures were taken during the year to encourage the development of non-farm sector.

Limits sanctioned to the SCBs for financing production and marketing activities of weavers societies increased to Rs.244 crores from Rs.224 crores last year.

Limits for financing activities other than weaving stood at Rs.7 crores.

To promote tiny/cottage industries and for supporting the activities of village artisans in rural and semi-urban areas, a comprehensive package of credit measures involving automatic refinance assistance was extended to all scheduled commercial banks (CBs).

Refinance disbursed for investment credit to the tiny and village industries and other non-farm rural activities has started picking up and stood at Rs.2.76 crores.

A Soft Loan Assistance Fund for Margin Money was established for providing loans to poor entrepreneurs towards seed capital for setting up cottage, tiny and village industries.

As a promotional effort, it has been decided to take up pilot projects involving voluntary organisations to identify and develop rural artisan activities.

Poverty Alleviation

A sum of Rs.376 crores was provided by way of refinance for the Integrated Rural Development Programme (IRDP). This amount was 6.2 per cent higher as compared to refinance provided in the preceding year and accounted for 32 per cent of the total refinance disbursed.

Institutional Development

A 10-Point Programme for the rehabilitation of weak primary land development banks (PLDBs) and branches of State Land Development Banks (SLDBs) was launched. Additionally a 15-Point Programme was initiated for strengthening the selected primary agricultural credit societies (PACS) and large-sized adivasi multi-purpose societies (LAMPS) set up for the benefit of the tribal population.

Under the Programme of intensive development of PACS, 4595 societies were selected as on 30 June, 1986.

Special efforts were launched for the rehabilitation of SCBs in the North-Eastern Region.

Pilot Project' for strengthening the credit delivery system is being extended to additional 17 districts from July 1, 1986.

Credit limits sanctioned to regional rural banks (RRBs) for short-term and medium-term purposes aggregated Rs.270 crores.

Rural Economic Situation

The year 1985-86, which marked the beginning of the Seventh Five Year Plan, recorded a slightly better performance as compared to the previous year. Despite adverse rainfall conditions in several regions during 1984-86, the performance of the agricultural sector during the two years has amply demonstrated its resilience and greater ability to withstand weather hazards.

The annual plan for 1985-86 provided for larger public sector outlay to accelerate the tempo of agricultural development. The outlay for agriculture and rural development was increased from Rs.3,615 crores in 1984-85 to 3,649 crores in 1985-86, and for irrigation and flood control from Rs.2,649 crores to Rs.2,781 crores.

Irrespective of drought conditions in several regions, the foodgrains production is expected to be slightly higher than that of last year. The estimated production is placed at 148-149 million tonnes, as against 146.2 million tonnes in 1984-85. Overall agricultural production is likely to increase by nearly 1 per cent. A growth rate of 6.3 per cent in the industrial sector has been achieved, compared to 6.8 per cent in 1984-85. As a result, national income in real terms is expected to grow by about 4 per cent during 1985-86.

The performance of the agricultural sector in terms of input use and production during 1985-86 is compared below with that in 1984-85 :

(a) Inputs

Irrigation

Creation of an additional potential of 2.5 million hectares during the year 1985-86, as compared with 2.4 million hectares in 1984-85.

HYV Programme

Area coverage is expected to have increased to 57.4 million hectares from 55.4 million hectares.

Certified Seeds

Distribution is anticipated to show a significant increase to 5.59 lakh tonnes from 4.85 lakh tonnes.

Fertiliser (NPK) Consumption

Indications are that the consumption would have reached a record level of 90 lakh tonnes from 82.1 lakh tonnes.

Pesticides

Consumption is expected to have increased by 10 thousand tonnes of technical grade material (TGM) over 56 thousand tonnes in the previous year.

Seed Mini-kits

Fortyseven lakh kits meant for small and marginal farmers have been distributed in all the blocks of the country.

Rural Electrification and Energisation of Irrigation Pumpsets

Cumulatively, 3.8 lakh villages, constituting 66 per cent of the total villages, have been electrified, and about 59.69 lakh pumpsets energised.

(b) Production

Foodgrain Stocks

28.6 million tonnes of foodgrains were in stock in June 1986, compared with 29.2 million tonnes in June 1985.

Milk Production

Anticipated to have touched 42.3 million tonnes, compared with 40.2 million tonnes.

Egg Production

14,500 million as against 13,500 million.

Wool Production

39.8 million kgs. as against 38.7 million kgs.

Fish Production

30 million tonnes, as against 28.6 million tonnes.

Food Procurement

Rice and wheat together, upto the end of June 1986, amounted to 20.2 million tonnes, compared with 19.9 million tonnes during the corresponding period of last year.

Rural Credit

Disbursement of credit by cooperatives increased from Rs.3,250 crores to Rs.3,757 crores. Out of this, more than 40 per cent has been disbursed to the weaker sections.

Rural Deposits

Total deposits increased from Rs.13,740 crores to Rs.15,248 crores.

Based on the recommendations of the Commission for Agricultural Costs and Prices (CACP), the minimum support price for cane (with 8.5 per cent recovery) for the 1985-86 season has been fixed at Rs.165 per tonne and for the 1986-87 season the same has been fixed at Rs.170 per tonne. The announcement of minimum support price in advance had acted as an incentive for higher production.

Agriculture occupies a predominant place in India's economy. The key role of National Bank, as a premier institution involved in agriculture and

rural development, has been to ensure the overall growth of the agricultural sector and enhance the welfare of individual farmers and their families. Recognising this aspect of National Bank's functioning, World Bank has reiterated its intention to continue the support to National Bank for such activities in the years to come.

During the year, sugar repledge limits aggregating Rs.30 crores were sanctioned by the National Bank to 2 SCBs to enable them to meet the working capital requirements of cooperative sugar factories.

Loans aggregating Rs.6 crores were sanctioned by National Bank to State governments during 1985-86 (April-March) for their contribution to the share capital of cooperative credit institutions, as against Rs.7 crores sanctioned during the previous year. The drawals against the limits totalled Rs.7 crores, as against Rs.9 crores last year. The total loans outstanding against State governments as on 31 March 1986 stood at Rs.101 crores.

Refinance disbursed by National Bank during the year under schematic lending aggregated Rs.1,192 crores, registering an increase of 12.3 per cent over the previous year. The cumulative disbursements upto 30 June 1986 stood at Rs.6,619 crores.

Strengthening human resources to improve operational efficiency is a continuing goal with National Bank. During the year, a new batch of professionally qualified personnel from reputed Institutes of Management and the Indian Agricultural Research Institute was recruited to improve the skill base available in the Bank. Towards the same end, a wide range of training programmes are in operation for the existing staff.

National Bank has been focusing its attention on improving the health of the lending institutions in order to enable them to serve as effective channels for purveying credit to rural areas. A series of measures were initiated during the year by the National Bank to improve the health of the credit delivery system and to ensure adequate flow of credit for developmental activities in these areas.

The Pilot Project for strengthening credit delivery system which was implemented in 3 districts earlier, showed encouraging results. The Bank, therefore, decided to extend the project to 17 more districts, as agreed upon under NABARD Credit Project-I. National Bank also supplemented its rehabilitation programmes in the long-term cooperative credit structure by a 10-Point Programme of rehabilitation of the primary units of LDBs. Besides the programme for intensive development of PACS into multi-purpose institutions, a 15-Point Programme for improving

the efficiency of selected PACS and LAMPS in pilot project districts was also announced during the year.

Details of measures taken by National Bank during the year for increasing the efficiency of credit institutions are as follows :

I. Cooperative Credit Institutions

(A) Primary Agricultural Credit Societies

The programme of intensive development of PACS for transforming them into efficient multi-purpose units continued to be monitored by the National Bank. Under the programme, 4595 societies in 16 States/Union Territories were selected. Data collected on a pilot basis from Haryana, Karnataka, Kerala and Madhya Pradesh indicated that the selected PACS in these States recorded considerable progress in mobilisation of deposits and in credit and non-credit activities under the past two years as a result of the programme of intensive development of PACS.

(B) Rehabilitation of CCBs

The scheme of rehabilitation of CCBs was introduced in 1971. The progress in this regard has been very slow. The number of CCBs identified as weak, with reference to their financial position as on 30 June 1985, stood at 165. With a view to identifying the problems in the implementation of the programme and to suggest remedial measures, National Bank undertook evaluation studies of 14 CCBs in 12 States. An action programme which includes intensive recovery drive, strengthening of resources position, rationalisation of loan policies and procedures, toning up of management, etc. was indicated by National Bank to the appropriate authorities for implementation.

Regional Offices of National Bank are actively involved in rehabilitation measures and providing necessary guidance and help to the 'weak' central cooperative banks. As a result, there was a positive growth in the deposits and advances of the weak banks under rehabilitation as on 30 June 1985 in Andhra Pradesh, Maharashtra, Gujarat, Karnataka and West Bengal compared with the position as on 30 June, 1984.

(C) Rehabilitation of SCBs

in the North-Eastern Region

The financial position of Manipur SCB was studied by National Bank in December 1985, to assist the State government to draw up an action programme for its rehabilitation. The proposed programme would cover, inter alia, segregation of chronic overdues and recovering them within a period of 10 years, providing fresh loans to non-wilful defaulters, taking coercive measures against wilful defaulters and steps for reviving the primary credit societies. Under

the programme of rehabilitation, the facility of blocking of overdues was extended to cover overdues upto 30 June 1983 in the case of Meghalaya SCB and upto 30 June 1985 in the case of Tripura SCB.

(D) Land Development Banks

(i) COTELCOOP

The Committee on Term Lending through Cooperatives (COTELCOOP) met once during the year to review the performance of cooperative credit institutions and the progress made in the rehabilitation of weak CCBs/SLDBs and PLDBs in the country.

(ii) Standing Committee on Cooperative Credit

COTELCOOP, which was mainly concerned with the policies on long-term lending, was reconstituted by the National Bank during the year as the 'Standing Committee on Cooperative Credit' (SCCC). The committee, with a total membership of 16, comprising representatives of GOI, RBI, two National Level Federations of short-term and long-term credit institutions, SCBs, SLDBs and Registrars of Cooperative Societies, would be chaired by the Chairman of National Bank.

(iii) Rehabilitation of Weak SLDBs and PLDBs

The Committee on Agricultural Productivity in Eastern India (Dr. Sen Committee) had recommended improvement in the flow of credit for investment in agriculture through the cooperative long-term credit structure. In view of the weak cooperative credit structure in the Region, the Bank formulated a 10-Point Action Programme for the rehabilitation of weak PLDBs and branches of SLDBs. The Programme was later extended to cover all States.

Working Group of LDB Structure

The Working Group set up under the Chairmanship of Shri V.I. Rajagopal, to study the problems of LDBs, referred to in the last report, submitted its report during the year. National Bank has initiated follow-up action on the report.

Review of Staffing Norms in LDBs

A sub-group of COTELCOOP which was appointed by National Bank to review the staffing norms in LDBs and suggest incentive schemes for loan recovery and information system, submitted its report during the year. The recommendations of the sub-group have since been circulated to all SLDBs for their consideration.

Commercial Banks

The Working Group appointed last year by the National Bank on the advice of the Committee on Agricultural Loans through Commercial Banks (CALCOB) since finalised the format of the Loan Pass Book to be introduced for all borrowers of loans

for agriculture and rural development. Accordingly, the RRBs were advised to introduce the pass book and RBI was requested to issue suitable instructions to CBs in this regard.

Regional Rural Banks

National Bank continued its involvement in overseeing the working of RRBs and setting up of new RRBs. During the year, 11 new RRBs were established increasing their total number as on 30 June 1986 to 194 (covering 342 districts) as against 183 RRBs (covering 322 districts) last year.

Discussions with the Officials of State Governments and Banks

The Chairman, Managing Director and Chief General Manager of the National Bank continued to hold discussions with the representatives of State governments/Union Territories and financing banks on important issues relating to cooperatives, agriculture and rural development, etc. During the year, 8 such discussions were held.

Inspection of Banks

With a view to adhering to the accepted programme of bank inspections, steps were taken during the year to rationalise the composition of inspection team, time for inspections, etc. In order to improve the quality of inspections, inspection oriented training programmes had been arranged for officers of National Bank at the Bankers Institute for Rural Development, Lucknow. During the year under review, 317 institutions comprising 180 CCBs, 9 SCBs, 12 SLDBs, 104 RRBs and 112 other institutions, were inspected as against 315 institutions during 1984-85.

Training

As a part of human resources development, training continued to be accorded high priority in National Bank. It received further impetus under NABARD Credit Project-I' which sets apart US \$ 6.5 million for strengthening of National Bank's training system and activities. Under this project, a comprehensive plan for training the staff of National Bank and those of the participating banks, proper staffing of the Training Division at the Head Office of National Bank and creation of training cells in its Regional Offices has been worked out for implementation during 1986-89.

Sources and Uses of Funds

The net increase in the financial resources of National Bank during the year was to the tune of Rs.762 crores compared to Rs.541 crores during 1984-85. Contributions from RBI and National Bank out of their respective operating surpluses to the two National Rural Credit Funds, increase borrowings from RBI, subscription to the Fourth and Fifth Series of Bonds

floated by the Bank and acceptance of deposits from Tea Companies contributed to the augmentation of resources. The details of sources and uses of funds are presented in Table I.

Capital

There was no increase in capital over the last year's level of Rs.100 crores.

Borrowings from GOI

The borrowings from GOI during the year, by way of reimbursement against amounts disbursed for various projects supported by external credit agencies, amounted to Rs.68 crores. These borrowings comprised Rs.43 crores under IDA / IBRD Projects and Rs.25 crores under credit by other international agencies/donor countries. The latter assistance was from U.K. (Rs.2.34 crores), KfW, Federal Republic of Germany (Rs.1.32 crores), Switzerland Credit (Rs.20.77 crores) and the EEC Credit (Rs.0.47 crores). After accounting for repayments of Rs.74 crores made during the year, outstanding borrowings from GOI stood at Rs.1,610 crores as on 30 June, 1986.

Market Borrowings

The Fourth and Fifth Series of Bonds were issued during the year, providing an amount of Rs.91.23 crores. These Bonds, issued at par, have a maturity period of 13 years and carry an interest rate of 9.75 per cent per annum. The Bonds of the erstwhile ARDC (V, VI, IX and X Series) for Rs.66 crores were redeemed during the year. Thus, the net resources mobilised during the year through market borrowings amounted to Rs.25.23 crores, while the borrowings outstanding under this head as on 30 June, 1986 amounted to Rs.478 crores, recording an increase of 5.6 per cent over the corresponding amount an year ago.

Deposits from Tea Companies

The total deposits under this scheme aggregated Rs.43.79 crores involving 106 companies.

Borrowings from RBI

RBI sanctioned a General Line of Credit amounting to Rs.1,300 crores under Section 17 (4E) of the RBI Act, 1934, for the year 1985-86. As on 30 June, 1986, the outstandings to RBI stood at Rs.861 crores, compared to Rs.762 crores as on 30 June 1985. The maximum outstanding reached during 1985-86 at Rs.1,288.86 crores constituted 99 per cent of the limit sanctioned as compared with Rs.1,219 crores (93.8 per cent of the limit sanctioned) during 1984-85.

Contributions by National Bank and RBI to NRC (LTO) Fund and NRC (Stabilisation) Fund

The contributions made by National Bank to the NRC (LTO) Fund and the NRC (Stabilisation) Fund during 1985-86 were Rs.190 crores and Rs.10 crores as against Rs.140 crores and Rs.15 crores respectively

during 1984-85. The RBI contributed Rs.300 crores to the NRC (LTO) Fund and Rs.25 crores to the NRC (Stabilisation) Fund for the year 1985-86 as against Rs.275 crores and Rs.80 crores respectively during 1984-85.

Board of Directors

The Board of Directors of National Bank met on seven occasions during the year. Dr. P.D. Ojha, Deputy Governor, Reserve Bank of India was nominated as a Director on the Board in place of Dr. C. Rangarajan. Shri A. S. Melkote, consequent on his appointment as Development Commissioner-cum-Agricultural Production Commissioner, Government of Karnataka, and Shri S. N. Acharya, consequent on his appointment as Agricultural Production Commissioner, Government of Uttar Pradesh, became Directors on the Board vice Shri P. R. Nayak and Shri M. Varadarajan respectively.

Shri M. N. Nambiar, one of the Directors of National Bank, unfortunately expired on 3 September, 1985. The vacancy caused by his demise has not yet been filled.

Shri C. Srinivasa Sastry, Secretary, Ministry of Agriculture, GOI was nominated as Director in place of Shri M. Subramanian.

Representation of Scheduled Castes and Tribes

The National Bank's policy of providing reservations in favour of SCs and STs in the vacancies filled by direct recruitment as also by promotions was continued during the year.

Table 1
Resources and Uses

Resources and Uses	Position as on 30 June 1985	net accretion/utilisation during 1985-86	Position as on 30 June 1986
Sources of Funds			
Capital	100	-	100
Reserves & Surplus	187	41	228
NRC (LTO) Fund	1,992	490	2,482
NRC (Stabilisation) Fund	628	35	663
Deposits	24	46	70
Bonds & Debentures	453	25	478
Borrowings from GOI	1,616	-6	1,610
Borrowings from RBI	762	99	861
Other Liabilities	72	32	104
	5,834	762	6,596

Uses of Funds

Loans & Advances :

(a) Production and marketing credit	765	133	898
(b) Conversion of short-term loans for production credit into medium-term loans	120	22	142
(c) Medium-term Investment credit (non-project loans)	158	10	168
(d) Other investment credit :			
i) Medium-term and long-term project loans	3,333	567	3,900
ii) Long-term non-project loans	105	-9	96
	4,481	723	5,204

Silver Jubilee Year 1986-87 Greetings

**SAHAKAR MAHARSHI SHANKARRAO
MOHITE PATIL
SAHAKARI SAKHAR KARKHANA
LIMITED**

SHANKARNAGAR - AKLUJ

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Various Schemes and Projects sponsored and implemented by our Beloved Leader Late SAHAKAR MAHARSHI SHANKARRAO NARAYANRAO MOHITE-PATIL have undoubtedly helped to raise the standard of living of poor and marginal farmers and have made them self reliant.

T. S. Hange

Vice-Chairman

V. S. Mohite-Patil

M. L. A.
Chairman

D. G. Mane

B. A.
Managing Director

Table 2

Credit limits sanctioned to State Cooperative Banks and Loans to State Governments

Term-wise / Purpose-wise Finance / Period of Limits	Year	Limits sanctioned	Drawals	Repayments	Outstanding
(i) Seasonal agricultural operations (at 3% below Bank Rate) July June	1984-85 1985-86	123252 120882	157808 169797	171617 159390	44641 55048
(ii) Marketing of crops other than cotton (at Bank Rate) July June	1984-85 1985-86	2335 3685	3200 6547	3209 6548	1 -
(iii) Marketing of cotton and kapas including monopoly procurement of cotton (at Bank Rate) July June	1984-85 1985-86	350 350	21 150	- 171	21 -
(iv) Purchase and distribution of fertilizers (at 1% above Bank Rate) January December	1984 1985	1983 2902	1759 4795	617 4011	1617 2401
(v) Production and marketing of handloom products (at 2-1/2% below Bank Rate) April March	1984-85 1985-86	22410 24450	37562 36177	35654 36645	15389 15921
(vi) Financing of other cottage and small-scale industries (at 2-1/2% below Bank Rate) April March	1984-85 1985-86	845 728	474 543	494 485	484 542
(vii) Purchase and sale of yarn (Bank Rate) April March	1984-85 1985-86	880 1102	525 3265	541 2868	176 574
(viii) Against pledge of sugar (at 5% above Bank Rate) July June (specified period)	1984-85 1985-86	1000 3000	- 500	- 500	- -
(ix) Against pledge of securities earmarked under ACS Fund for meeting SCB share in M.T. conversion loans (Bank Rate) July June (specified period)	1984-85 1985-86	- 190	- 137	411 -	- 187

A Leading Bank in Cooperative Sector



Janata Sahakari Bank Ltd., Poona

1444, Shukrawar Peth,
Thorale Bajirao Road,
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Tel: 443258/59, 32894

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S. M. Nabar - President

V. N. Sathe	-	Chairman	V. V. Apte	-	Vice Chairman
B. R. Kirad	-	Director	A. B. Gondkar	-	Director
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S. B. Kamble	-	Director	H. N. Kunden	-	Managing Director

THE INDUSTRIAL CREDIT AND INVESTMENT CORPORATION OF INDIA

163, Backbay Reclamation,
Bombay 400 020

An Institution to promote and Assist Development of Industry

The Industrial Credit and Investment Corporation of India (ICICI) is a financial institution set up in 1955 to encourage and assist industrial development and investment in India.

The decision to set up a development finance institution emerged in 1953, in the course of discussions between representatives of the Government of India, the Foreign Operations Administration of the United States Government and the International Bank for Reconstruction and Development (the World Bank). Negotiations, in 1954, between a Steering Committee of five prominent Indian businessmen or representatives of the World Bank, the Commonwealth Development Finance Company Limited and others culminated in the formation of ICICI as a public limited company on January 5, 1955.

The objectives, inter alia, include providing assistance in the creation, expansion and modernisation of industrial enterprises, encouraging and promoting the participation of capital in such enterprises and encouraging and promoting industrial investment and the expansion of capital markets. These objectives are pursued by providing finance in the form of long and medium-term loans or equity participation, sponsoring and underwriting issues of shares and debentures, guaranteeing rupee and foreign currency loans from other sources, making funds available for reinvestment by revoking fixed investments as rapidly as prudent and furnishing management, technical and administrative advice to Indian industry.

The primary function of ICICI is to act as a channel for providing development finance to industry. While performing this function, it has been ICICI's constant endeavour to play a more effective role in the nation's economic development by adapting its operations to the changing needs of the nation's economy.

Finance for Industry

In pursuit of its objectives of promoting industrial

development, ICICI provides financial assistance to enterprises in various forms, such as :

- (a) underwriting of public and private issues and offers of sales of industrial securities - ordinary shares, preference shares, bonds and debenture stock;
- (b) direct subscription to such securities;
- (c) loans in rupees, repayable over periods up to 15 years;
- (d) similar loans in foreign currencies for payment for imported capital equipment and technical services;
- (e) guaranteeing payments for credits given by Indian and foreign sources;
- (f) credit facilities to indigenous manufacturers for promoting sale of industrial equipment on deferred payment terms;
- (g) equipment leasing facility;
- (h) merchant banking services; and
- (i) project counselling for non-resident Indians.

The primary purpose of ICICI's assistance is to provide long-term funds for capital assets like land, buildings and machinery. Of the alternative types of assistance provided by ICICI, the one best calculated to assure the success of the enterprise is chosen in each case.

Any company with limited liability (or the promoter of such a company), any sole proprietary concern, partnership firm and any cooperative society may approach ICICI for assistance in financing a sound proposal for establishing, expansion or modernisation of an industrial enterprise. The applicant's plan may provide for investment in any part of India, he may require assistance in any form. He must, however, be prepared to make a reasonable contribution to the resources required for his proposal. The enterprise should have, or should undertake to obtain, experienced

management and expert technical personnel. Special consideration is given to projects promoted by new entrepreneurs and to those established in backward areas as also modernisation projects.

There are no firm limits on the size of the enterprises ICICI is prepared to assist, nor is there a maximum or minimum limit on the assistance that it may offer. In practice, the lower limit on the projects assisted by ICICI is set at a project size of Rs.3 crore as there are other institutions which provide assistance to smaller enterprises. However, to meet the requirement of industry for loans in foreign currency, ICICI may offer assistance below this limit. At the upper end, prudence requires that ICICI limit the proportion of its resources which it can safely invest in a single enterprise. However, no proposal is too large for ICICI to handle; it is prepared to enlist the cooperation of other financing institutions, in India and abroad, to share in the investment.

In promoting industrial investment, ICICI is anxious not only to invest, but also to encourage others to invest. Accordingly, it seeks to encourage other financial institutions and individuals, both Indian and foreign, to collaborate in its investment and lending operations. Wherever necessary, ICICI operates in consortium with the Indian financial institutions, namely, Industrial Development Bank of India (IDBI), Industrial Finance Corporation of India (IFCI), Life Insurance Corporation of India, Unit Trust of India, General Insurance Corporation of India, various state financial institutions and commercial banks. It also cooperates in a similar manner with foreign institutions such as the International Finance Corporation, Washington, the Kreditanstalt für Wiederaufbau (KfW), West Germany and the Deutsche Entwicklungs Gesellschaft, West Germany. It also cooperates with organisations offering export credit facilities and Eurodollar loans.

ICICI sells securities from its own portfolio to investors whenever it can get a reasonable price for them. It does so for the dual purpose of revolving its resources for new investments and for encouraging the investment habit in the public thereby promoting widespread distribution of private industrial securities. Thus, unlike the normal investor, ICICI does not retain successful investments merely because they are profitable. On the contrary, dissemination of profitable investments is in accord with its broad objectives and the form of ICICI's own investment in a particular enterprise is often influenced by the prospect of selling it eventually.

Other Development Facets

Although provision of direct finance is the principal function of ICICI, it offers a wider range of services to cater for the variety of needs its clients

may have.

Export Development

Foreign currency loans are provided on softer terms to companies manufacturing or proposing to manufacture products which have export potential. Projects eligible for such assistance include those for technology upgradation, modernisation, balancing, expansion or new projects which would enable the company to compete effectively in the international markets in quality as well as cost.

Companies and ancillaries manufacturing engineering products and components with identified export prospects proposing productivity improvements to reach international price and standard specifications, are eligible for a grant up to 50% of the proposed productivity scheme.

Expenditure eligible for each grant would include foreign exchange cost of productivity consultants and technicians, ancillary development consultancy, design and product adaptation consultancy, supervisor training, exposure to plants in competing countries, workshops, seminars and firm-level work by potential collaborators. Expenditure up to US \$ 25,000 on acquiring design/process know-how, R&D prototype development, jigs, fixtures and tools would also be eligible in order to enable companies adapt to the export demand.

Leasing

In 1983, the Corporation commenced leasing operations. The instrument of finance, which enables industries to acquire the use of fixed assets, has been popular in the developed countries and is being increasingly adopted in developing countries also. Leasing allows clients to make payments over a period through expected earnings from the use of capital assets.

Merchant Banking

ICICI Merchant Banking Division advises clients, on a selective basis, on raising finance in suitable forms, in rupees and foreign currencies and on restructuring of finances in existing companies. It also advises clients on amalgamation proposals. Assistance is provided in preparing proposals for submission to financial institutions and banks and for negotiations with them for loans and underwriting. The Division acts as Managers to the Issue of Capital. Assistance is also provided for completion of formalities connected with public issues and legal formalities for raising loans, ICICI charges a suitable fee for these services.

Facilities for Non-Resident Indians

To assist the large community of non-resident Indians to invest their savings judiciously in Indian industry, the Corporation had brought out in 1983 a publication which provides information on facilities

and incentives made available to them by Government of India. The Merchants Banking Division of ICICI has been geared to offer investment advice as also counselling for setting up industrial projects in India.

Letters of Credit

ICICI opens commercial letters of credit under various foreign currency loans granted to its clients in order to reduce delays occurring at different stages and to render an additional service to entrepreneurs. This service has now also been extended to clients who have been sanctioned rupee assistance by ICICI for import of equipment against other foreign currency sources. ICICI has established correspondent relationship with several banks abroad.

Project Promotion

Consistent with its corporate philosophy and its role as a experienced development bank, ICICI provides promotional assistance to worthwhile projects. The Corporation has provided, on a formal basis promotional assistance like identification of new projects on the one hand and location of suitable entrepreneurs on the other. In selecting projects for this purpose, preference is given to those with a potential to cover immediate and emergent gaps in the economy. Special consideration is also given to new products and processes. ICICI provides comprehensive guidance to entrepreneurs on selected projects for their formulation on sound lines and expeditious maturing to a bankable stage. In suitable cases a small fee is charged for these services.

Backward Area Development

Towards the national objective of development of backward regions, ICICI has been extending financial assistance on concessional terms to new projects located in backward areas. Concessional finance is also considered for projects in specified backward districts, to be set up by existing concerns by way of expansion or diversification. The concessions relate to lower interest rates, commitment charge and underwriting commission and longer moratorium and repayment periods. ICICI also provides subsidy for projects in specified backward areas on behalf of the Government of India.

ICICI played an active role in the techno-economic surveys of various States under the initiative of the all-India financial institutions. The surveys were carried out to determine the industrial potential of the selected States and to suggest measures for realising such potential. The effort was to identify specific projects based on local resources, which would be of maximum benefit to the economy. ICICI in close coordination with other all-India financial institutions, State level financial and promotional institutions and nationalised banks, is now taking follow-up action on the survey reports. / Along with other financial

institutions, ICICI has participated in promoting and financing industrial and technical consultancy organisations (ITCOs) at the State level.

Regional Offices

ICICI has three regional offices - in Calcutta, Madras and New Delhi - for fostering closer relations with clients and for providing better service to entrepreneurs. Realising the need for giving special attention to industrial efforts in the north-eastern region of the country, the Corporation set up a development office at Guwahati.

Rural Development

ICICI considers financial assistance on soft terms to suitable rural development schemes initiated either by voluntary organisations or corporate bodies. The schemes should have a demonstration value and be replicable in other rural areas. They should aim at improving living conditions of the rural population and their impact should be measurable. For bankable rural development scheme, ICICI extends financial assistance in the form of seed money/margin money or suitable interest rate subsidy.

Institute for Financial Management and Research

ICICI has been instrumental in setting up the Institute for Financial Management and Research at Madras. Recognising the importance of advanced financial techniques in the management of enterprises, ICICI devoted considerable efforts and attention to the setting up of the Institute which has been conducting specialised courses and carrying on research in the field of financial management.

Housing Development Finance Corporation

An important development initiative taken by ICICI resulted in the formation of Housing Development Corporation Limited (HDFC). HDFC provides long-term loans on reasonable terms, primarily for lower and middle income group housing.

Institute for Foremen Training

The Corporation has set up with the support of the Government of Orissa and the corporate sector an Institute for Foremen Training at Kansbahal, Orissa, to provide training facilities for shopfloor supervisors who are an important link between workers and management.

Entrepreneurship Development Institute of India

ICICI has been a co-sponsor of the Entrepreneurship Development Institute of India at Ahmedabad which provides facilities for training trainers engaged in entrepreneurship development activity and for conducting comprehensive demonstration entrepreneurship development programme.

Programme for Advancement of Commercial Technology

The Governments of India and the United States

of America have signed an agreement entitled the Programme for the Advancement of Commercial Technology under which ICICI is administering a US \$ 10 million grant for supporting suitable R & D joint venture projects between Indian and American companies to stimulate the joint development of commercialisation of innovative technology-based products and processes from which both countries would derive benefits.

Conferences and Seminars

The Corporation undertakes studies on various facets of its operations, it has organised several discussions on various subjects during the last 30 years.

ICICI Publications

ICICI conducts studies on topics of interest for development banks, industrial companies and publishes articles on subjects like incentives for industries in backward areas, economic rate of return, export performance of companies, socio-economic change, rural development, rehabilitation of problem projects, rural marketing and financial ratios as fore-warning indicators of corporate sickness.

Relationship with other

Development Finance Institutions

ICICI maintains close relations with other all-India and state financial institutions and banks. The experience gained by the Corporation over three decades of operation is made available to other development institutions. ICICI receives officials from other development finance companies, including overseas institutions for study of ICICI's procedures and methods of work. Under the Corporation's Annual Training Programme three officers from development banks in foreign countries receive training every year at ICICI at its expense. Officers of ICICI have worked with other development finance institutions in India and abroad, for setting up and operation of these institutions. In addition, ICICI has been seconding its staff to faculties of various training institutions in India and abroad.

ICICI offers know-how on development banking to institutions in some of the third world countries. Such assistance has so far been provided to National Development Bank, Sri Lanka, Bank for Housing and Construction, Ghana, National Development Bank of Jamaica and Nepal Industrial Development Corporation.

Resources and Operations

Resources

ICICI's authorised capital is Rs.100 crores of which Rs.49.50 crores has been subscribed and paid-up till December 31, 1985. Nearly 11 per cent of the share capital is held by foreign shareholders. The major Indian institutional shareholders are Life

Insurance Corporation of India, General Insurance Corporation of India and its subsidiaries, Unit Trust of India and banks. ICICI has now 6000 shareholders. Of the Rs.13.50 crores convertible debenture issue made in 1981, Rs.9 crores has been converted into equity shares.

The equity of the Corporation has been supplemented by borrowings from Government of India, the World Bank, the Development Loan Fund (now merged with the Agency for International Development), Kreditanstalt für Wiederaufbau (an agency of the Government of the Federal Republic of Germany), Government of the UK and Industrial Development Bank of India. The resources of the Corporation have been further augmented by raising debentures/bonds in India and commercial markets abroad. The commercial borrowings abroad comprise bond issues in Switzerland and Japan, a Floating Rate Note Issue and syndicated loans from Eurocurrency markets and export credits from UK and Switzerland.

The Government of India granted four loans aggregating Rs.32.5 crores which have been fully repaid. ICICI received, by way of budgetary allocation, a loan from the Government of India amounting to Rs.20 crores during 1982. Till the end of December 1985, the Industrial Development Bank of India had granted loans aggregating Rs.173.42 crores. Up to the end of December 1985, ICICI made debenture/bond issues aggregating Rs.1134.84 crores.

With a view to enlarge the entrepreneurial base which was narrow and restricted and in line with the national policy, ICICI has helped many new entrants in the field of industry with funds and technical guidance. By the end of 1985, ICICI had assisted 434 new entrepreneurs to set up industries in various fields. The aggregate financial assistance to such enterprises amounted to Rs.370 crores. The new entrepreneurs have emerged from diverse socio-economic backgrounds, from amongst landlords, agriculturists, traders, civil servants, technicians and other professionals.

Procedures and Requirements

For Obtaining Financial Assistance by Entrepreneurs

ICICI does not regard itself as a mere provider of finance but as a financial partner, prepared to advise and assist at all stages in the planning and execution of an investment proposal.

Terms of Financial Assistance

The terms for loans and other financial assistance are quoted for each case on its merits and decisions are made in the light of the risk involved, the prevailing conditions and practices of financial institutions and the cost of funds.

In the case of underwriting, the applicant

justified of the rates of ICICI's underwriting commission at the appropriate time and the commission is payable in accordance with the terms of the Letter of Underwriting.

In respect of loans, a commitment charge at a nominal rate is levied on the undrawn portion of the loan. The commitment charge is payable in respect of foreign currency loans from the date of issue of the letter of assistance, while in case of rupee loans it is payable from the date of signing of the Heads of Agreement or 180 days from the date of the sanction letter, whichever is earlier. Full interest accrues on the portions of the loan disbursed, in the case of guarantees, a commission is charged on the amount guaranteed. In some cases of loan operations, ICICI tries to share in the earnings by asking for a firm allotment of shares in the case of public limited companies or by charging a contingent interest based on the profit level in the case of private limited companies. In certain cases, ICICI also asks for option to convert a part of its loan into ordinary shares at an agreed price during an agreed period.

As at December 31, 1985, the Corporation had repaid the equivalent of Rs.689.95 crores in foreign currencies to its foreign lenders and Rs.71.15 crores in rupees to Government of India and Industrial Development Bank of India. The Corporation has redeemed debentures aggregating Rs.31.5 crores.

The net resources of the Corporation at the end of 1985 amounted to Rs.2325.09 crores - Rs.1461.45 crores in rupees and an equivalent of Rs.863.64 crores in foreign currencies.

Data on Operations

Cumulative sanctions of the Corporation till December 31, 1985 aggregated Rs.4018 crores to 2258 enterprises, comprising foreign currency loans Rs.1655 crores, rupee loans Rs.1579 crores, underwriting and direct subscription Rs.320 crores, guarantees Rs.116 crores, suppliers' credit Rs.282 crores and leasing Rs.66 crores.

Of the total sanctions of Rs.4018 crores, Rs.1389 crores had been disbursed in the form of foreign currency loans, rupee loans Rs.1263 crores, underwriting and direct subscription Rs.144 crores, guarantees Rs.1 crore, suppliers' credit Rs.178 crores and leasing Rs.32 crores. The aggregate assistance included sanctions of Rs.1551 crores to projects located in backward areas and Rs.290 crores rupee loans under the modernisation scheme in which part of the rupee loan carries a lower rate of interest.

The portfolio of ICICI at the end of December 1985 amounted Rs.1936 crores, comprising foreign currency loans Rs.687 crores, rupee loans Rs.1032 crores, underwriting and direct subscription Rs.90 crores,

guarantees Rs.1 crore, suppliers' credit Rs.101 crores and leasing Rs.25 crores.

Impact of Operations

As a result of its operations so far, ICICI expects to bring about a total capital mobilisation of Rs.25460 crores and the direct increase in jobs would be about 11 lac.

Until the end of December 1985, ICICI had approved investments and loans for 2258 enterprises, distributed throughout the country, of which 1149 were new undertakings. The major fields of investment have been textiles, chemicals and chemical products including fertilisers, basic metal industries, metal products and machinery, electrical and transport equipment.

Loans are granted for periods up to 15 years. The repayment period depends on the estimated cash position of the enterprise and the purpose of the loan, ICICI normally allows a period of grace before repayment begins.

All loans and guarantees must be secured. As security for the loan, ICICI normally requires a party to create a mortgage over its moveable and immoveable assets, present and future, subject only to the charge for the party's bankers on specified current assets for working capital. In some cases, bank guarantees or other suitable securities are also considered adequate by ICICI.

For providing timely assistance, ICICI also advances interim funds by way of bridging loans against temporary security arrangements. Apart from security, ICICI may ask for certain financial covenants with the enterprise (such as limits on creation of additional debt) if such provision would help assure the financial soundness of the enterprise. To prevent the managerial and financial resources available to the enterprise from being over-extended, ICICI also requires that no new project or expansion is undertaken by the enterprise without prior permission. Further, ICICI requires an undertaking from the promoters that they would bring in funds to meet any shortfall in financing. In most cases, ICICI insists on the right to appoint a director on the Board of assisted companies.

In all cases, ICICI's actual out-of-pocket, legal or other expenses incurred in the examination of title to properties, the preparation of documents, etc. are recoverable from the applicant, who is also required to pay the out-of-pocket expenses of ICICI's representatives who may have to visit the factory, office or site. These expenses are recoverable irrespective of the eventual outcome of the application. ICICI reserves the right to levy a charge for its services in investigating a project, in addition to requesting reimbursement of out-of-pocket expenses.

MSSIDC: 25th glorious year of service to the small scale sector in Maharashtra.

A turnover of 100 crores.

This festive season we are entering our Silver Jubilee Year crossing a turnover of Rs. 100 crores. MSSIDC is proud of its significant contribution to the development of the small scale sector at district levels. However, we know we could never have hoped to achieve such a success without the unstinted support of the SSI Units, the Government and the Consignees at all stages. At all times. Thank you.

Services offered by MSSIDC:
Procurement and supply of raw materials • Commercial warehousing • Marketing • Exports • Employment Promotion Schemes • Handicrafts Development • Entrepreneurs Development Programmes and Industrial Exhibition.

Service is our business

MSSIDC

Maharashtra Small Scale Industries Development Corporation Limited.

Krupanidhi,

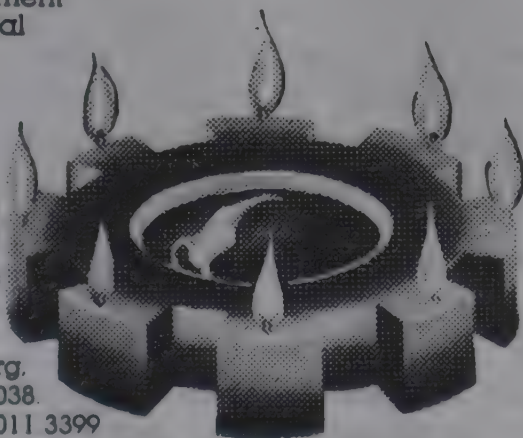
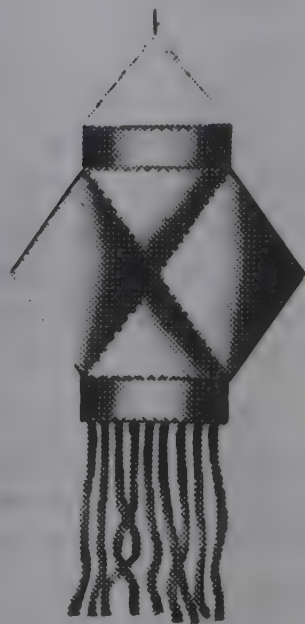
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Ballard Estate, Bombay 400 038.

Phone: 261121-22-23 Telex: 011 3399

Branch offices at Nagpur, Pune, Aurangabad,

Kolhapur, Nasik, Nanded, Akola, Delhi and Calcutta.



Disbursements

Since loans sanctioned by ICICI generally go towards acquisition of fixed assets; sums are advanced in suitable instalments according to the progress in the implementation of the project.

ICICI maintains a certain ratio between the amount of loan advanced from time to time and the value of the fixed assets acquired by the project. Rupee loans are advanced in accordance with the financial plan agreed to with the company. Requests for rupee loan disbursements should be accompanied by an up-to-date progress report on the project.

Follow-up Requirements

The signing of the formal contractual documents and disbursement of assistance is considered by ICICI as the beginning of a business relationship. The essential aim of follow-up is to nurture a partnership between ICICI and the company financed by it, to bring the project to successful function and satisfactory level of operation.

The assistance sanctioned by ICICI is for a specific project and ICICI needs to keep in touch with the progress of the project and the company being financed by it. Once assistance is sanctioned by ICICI and the client has accepted the terms of assistance, regular periodic reports are required to be furnished to ICICI at both the planning and construction stages and, subsequently, in the production phases.

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INDUSTRIAL FINANCE CORPORATION OF INDIA

Bank of Baroda Building,
16, Sansad Marg, P. B. No. 363,
NEW DELHI 110 001

Industrial Finance Corporation of India (IFCI) is a national level development bank, set up in 1948, soon after Independence, by an Act of Parliament with the objective of providing medium and long term finance to eligible industrial concerns in India.

IFCI's role extends to the entire industrial spectrum of the country encompassing principally (a) Project Financing Operations and (b) Promotional Activities.

Under its Project Financing Operations, IFCI provides direct financial assistance for setting up new industrial projects as also for the expansion, diversification and modernisation of existing ones, in the form of rupee and foreign currency loans, underwriting and/or direct subscription to shares/debentures as also guarantees for deferred payments and foreign loans, to all medium, medium-large and large-sized industrial projects set up or proposed to be set up in the country in the corporate and co-operative sectors.

IFCI has been designated as nodal agency for administering "Sugar Development Fund" and "Jute Modernisation Fund" established by the Government of India.

Project Financing Operations of IFCI during 1985-86

Sanctions and disbursements of financial assistance to industrial concerns by IFCI scaled new heights in 1985-86 surpassing all previous records. Sanctions for the year 1985-86 crossed, for the first time, Rs.500 crores mark and aggregated Rs.579.45 crores to 365 industrial projects indicating a growth rate of 22.6% over the net sanctions of Rs.472.62 crores achieved in 1984-85.

Disbursements during the year also crossed, for the first time, Rs.400 crores mark and aggregated Rs.413.92 crores indicating an increase of 30.2% over the disbursement of Rs.317.95 crores (growth rate 22.2%) recorded in 1984-85.

In the area of foreign currency loans, IFCI's performance was still more impressive. The foreign currency loans disbursements equivalent to Rs.87.08 crores during the year, achieved an all time high of 143% over the foreign currency loans disbursements

in the preceding year.

In its operations, IFCI continued to attach considerable importance to the modernisation and technology upgradation of various industries. Assistance to modernisation schemes to the extent of Rs.76.17 crores during the year was higher by 20.7% over the modernisations assistance under the Soft Loans Scheme sanctioned to the extent of Rs.63.12 crores in 1984-85.

62.4% of the total assistance sanctioned by IFCI in the year 1985-86 went to 127 new projects. These included 12 new projects set up by first generation entrepreneurs in the medium-large scale industries sector.

Of the total assistance sanctioned by IFCI in 1985-86, 40 projects in Category 'A' (No-Industry/Special Region) districts claimed assistance of the order of Rs.91.92 crores, the assistance to 68 projects in Category 'B' districts and 77 projects in Category 'C' Rs.99.33 crores respectively. In aggregate terms, 55.8% i.e. Rs.323.57 crores out of the total assistance sanctioned went to industrial projects located/to be located in industrially backward districts/areas.

Assistance of the order of Rs.43.68 crores to 20 industrial projects in the co-operative sector recorded an impressive high of 65.1% over the assistance sanctioned to industrial cooperatives in the preceding year. Industrial cooperatives assisted during the year included 13 sugar cooperatives, 3 textile cooperatives and one each relating to paper, fertilisers, synthetic fibres and chemicals.

In the corporate sector, 345 projects claimed an assistance of Rs.535.77 crores, of which 284 projects in the private sector had an assistance of Rs.399.23 crores (68.9% of the total), which was higher by 20.6% over the assistance sanctioned to projects in the private corporate sector in the previous year.

The share of assistance of basic industries was the highest (47.7%), followed by intermediate goods industries (23.5), consumer goods industries (16.4%), capital goods industries (10.8%) and service industries (1.6%).

The total sanctions and disbursements of IFCI in 1985-86, which was the first year of the Seventh Plan (1985-90), were higher by 191.6% and 209.6% of the sanctions and disbursements during the first year of the Sixth Plan period (1980-85).

Cumulatively, upto the 30th June, 1986, the assistance sanctioned by IFCI amounted to Rs.3231.67 crores to 2272 projects of 1864 concerns spread all over the country. The cumulative disbursements as on the 30th June, 1986, amounted to Rs.2379.69 crores. The cumulative sanctions and disbursements, industry-wise and sector-wise, is given in Annexure.

Promotional Activities of IFCI

Since IFCI's role in the field of direct financing is confined to providing finance to the medium, medium-large and large scale industrial units in the corporate and cooperative sectors, in its developmental and promotional role, IFCI has been endeavouring, to the extent possible, to take such steps as are considered necessary for preparing the base, leading to the deepening of the process of industrialisation in the country in its multi-faceted form. IFCI's efforts in this direction are towards (a) filling in gaps either in institutional infrastructure necessary for promotion and growth of industries or in regard to provision of much-needed guidance in project identification, formulation, implementation, operation etc., (b) development and broad-basing the entrepreneurship, (c) upgrading the managerial skills, (d) providing encouragement to new and small entrepreneurs, (e) encouraging the use and manufacture of equipment relating to bio-gas and other renewable energy sources, (g) reviving sick units in the tiny and small scale sector, (h) encouraging self-development and self-employment of unemployed young persons, etc.

For the fulfilment of the aforesaid objectives, IFCI has set up, either on its own, or jointly with other Financial Institutions, certain agencies, and has been helping certain specified bodies engaged in the development of entrepreneurship. IFCI has also devised a number of Promotional Schemes, which are production-oriented and aim at improving the productivity of human and material resources.

With a view to providing low-cost but quality consultancy services from concept to commissioning stage to tiny, small and medium scale entrepreneurs, IFCI, along with other national and state-level financial institutions and banks, has set up 16 Technical Consultancy Organisations (TCOs). These 16 TCOs, along with the one TCO, sponsored by the Government of Karnataka, had executed 2,786 assignments in 1985-86 and cumulatively 19,868 assignments upto the 30th June, 1986.

The Risk Capital Foundation (RCF), sponsored

by IFCI in 1975 to help new entrepreneurs in raising their share of promoters' equity, provided during the year 1985 risk capital assistance of the order of Rs.238.87 lakhs to 33 promoters in respect of their 19 projects. Subsequent to that RCF, during the six months' period ended the 30th June, 1986, had provided risk capital assistance of Rs.97.00 lakhs to 12 entrepreneurs in respect of 7 projects promoted by them. Cumulatively, RCF's assistance, from its inception upto the 30th June, 1986, of the order of Rs.1026.34 lakhs reached 170 promoters of 101 industrial projects. During the year 1985-86, a blue print of the Scheme of Technology Finance was formalised, and it was decided to convert RCF into a Company with an authorised capital of Rs.10.00 crores with one objective of taking up not only the existing activities of RCF but also the Scheme of Technology Development and Finance with effect from the 1st January, 1987.

The Management Development Institute (MDI) and its Development Banking Centre (DBC) established by IFCI for providing training in modern management techniques with a view to upgrading the managerial skills and inculcating the professionalisation of management in the industry, conducted in the year 1985, 94 training programmes benefitting 2118 participants, of whom 36 were from other developing countries. During the next six months period ended the 30th June, 1986, MDI and DBC had conducted 37 programmes benefitting 727 participants. Cumulatively upto the 30th June, 1986, MDI and DBC conducted 713 programmes benefiting 17,512 participants.

IFCI's contribution to entrepreneurship development has been by providing active support to (a) Entrepreneurship Development Programme (EDPs) conducted by TCOs and several other agencies all over the country, (b) Science & Technology EDPs conducted under the auspices of National Science & Technology Entrepreneurship Development Board (NSTEDB), (c) Entrepreneurship Development Institute of India (EDII) an apex level institution set up by the all-India Financial Institutions, and (d) State/Regional level Centres/Institutes for Entrepreneurship Development (CED/IED).

IFCI has also agreed to support Science & Technology Entrepreneurs Parks (STEPs) at Ranchi (Bihar) and Tarapur (Maharashtra).

Over the years, IFCI has built up good nexus with the Universities and Management Institute in the area of research and development in discipline relating to Development Banking, Financial & Industrial Management, Industrial Economics, etc. Six Chairs one each at the University of Bombay, Calcutta, Delhi, Guwahati and Madras and one at the India Institute of Management, Ahmedabad (IIMA) have been created by IFCI for promoting research in specific areas.

During 1985-86 three Lectures under the auspices of IFCI Chairs were held - one at the University of Bombay on the subject of 'Seventh Five Year Plan and the Private Corporate Industry in India', one at the University of Guwahati on the subject of 'Role of Small Scale Industries in Economic Development of North-East India' and one at the Indian Institute of Management, Ahmedabad, on the subject of 'Capitalisation of Interest on Long Term Borrowings'.

During 1985-86 four new Promotional Schemes were added, while the existing ones were considerably liberalised and improved with the result that as at the close of the year, IFCI was operating eleven Promotional Schemes as under :

Consultancy Fee Subsidy Schemes

- Scheme of Subsidy to Small Entrepreneurs in the Rural, Cottage, Tiny & Small Scale Sectors for meeting Cost of Feasibility Studies, etc.
- Scheme of Subsidy for Promotion of Ancillary and Small Scale Industries.
- Scheme of Subsidy to New Entrepreneurs for meeting Cost of Market Research/Surveys.
- Scheme of Subsidy for Providing Marketing Assistance to Small Scale Units.
- Scheme of Subsidy for Revival of Sick Units in the Tiny and Small Scale Sectors.
- Scheme of Subsidy for Implementing the Modernisation Programmes of Tiny, Small Scale & Ancillary Units.
- Scheme of Subsidy for Control of Pollution in the Small and Medium Scale Industrial Units.

Interest Subsidy Schemes

- Scheme of Interest Subsidy for Self - Development and Self - Employment of Unemployed young persons
- Scheme of Interest Subsidy for Women Entrepreneurs.
- Scheme of Interest Subsidy for Encouraging the Adoption of Indigenous Technology.

Assistance Scheme

Scheme of Assistance for Development of Technology Through In-House R&D Efforts.

Merchant Banking Facilities

In its role as a catalyst for industrial growth, from the 1st July, 1986, IFCI has offered effective Merchant Banking Services to the industrial community. The accent of Merchant Banking operations of IFCI, besides rendering issue management services, is on providing a package of facilities, particularly

to medium, medium-large and large scale enterprises in the corporate sector, which need specialised assistance or guidance in the formulation and implementation of new projects or modernisation/diversification of their existing activities.

The Merchant Banking Division, which has started functioning from New Delhi, is also providing entrepreneurial and opportunity guidance to the prospective entrepreneurs on all matters relating to the establishment of a medium or large-sized industrial unit in the corporate/cooperative sector. The Division would also be opening a 'Merchant Banking Bureau' at Bombay shortly.

Impact Of Catalytic Operations and Promotional Activities of IFCI

The endeavour of IFCI as a catalyst of industrial growth has been to fill in the gaps in the industrial infrastructure, wherever these have been identified. Experience has proved that no amount of fiscal and financial incentives alone or even easy availability of finance can bring success in industrialisation efforts, unless other inputs like resourceful entrepreneurship, latest and efficient technology/know-how, professionalised management, well-motivated and skilled manpower, coupled with project counselling facilities and extension services are available at every stage during the life-cycle of a project. Apart from industrial infrastructure facilities, the human resources are also required to be developed/re-oriented to meet the challenges they face in the industrial arena. The support of Institutions like IFCI to entrepreneurship development programmes has broken the myth that entrepreneurs are born and not made. Today, hundreds of capable young persons are being converted from the position of 'Job seekers' to 'Job givers' through the programmes on entrepreneurship and enterprise building. Professionalisation of management in industry has already taken roots. Entrepreneurial base is getting broadened and improvements in technological base have started taking place. Culture for consultancy has percolated at the tiniest industrial unit level. Need for ancillarisation, pollution control, energy conservation, etc., have been well recognised. Modernisation and technological upgradation of existing industrial units have started picking up. All these and several other qualitative achievements in the industrial arena have been possible to a considerable extent due to catalytic operations and promotional work of financial institutions, of whom IFCI is one and one of the earliest.

Annexure

Industry-wise and Sector-wise Distribution of Net Financial Assistance sanctioned and disbursed
(1948-1986)

(Figures in brackets denote the disbursements)

(Rs. Crores)

Industry	Cooperative Sector		Joint Sector		Public Sector		Private Sector		Total	
	No. of projects	Assistance sanctioned Rs.	No. of projects	Assistance sanctioned Rs.	No. of projects	Assistance sanctioned Rs.	No. of projects	Assistance sanctioned Rs.	No. of projects	Assistance sanctioned Rs.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Textiles	81	75.93 (65.09)	15	24.06 (20.06)	96	98.11 (86.14)	269	256.00 (208.59)	461	454.10 (379.88)
Cement	-	- (-)	8	39.77 (32.92)	14	35.69 (35.06)	113	283.91 (209.46)	135	359.37 (277.43)
Sugar	193	206.71 (191.64)	2	1.43 (1.37)	23	26.72 (25.88)	41	30.23 (28.12)	259	265.09 (247.01)
Synthetic fibres, resins, plastic materials & products	2	13.22 (2.50)	12	48.35 (28.34)	3	4.23 (2.46)	84	180.98 (107.50)	101	246.78 (140.80)
Basic industrial chemicals	-	- (-)	27	70.86 (37.03)	5	26.31 (20.71)	75	119.24 (74.18)	107	216.41 (131.92)
Iron & Steel	-	- (-)	15	23.10 (19.98)	6	5.76 (5.06)	128	176.62 (122.14)	149	205.48 (147.18)
Fertilisers & pesticides	4	33.00 (31.75)	8	62.98 (43.92)	4	12.81 (10.75)	43	89.40 (64.09)	59	198.19 (150.51)
Paper & paper products	4	4.45 (4.25)	15	25.92 (27.56)	2	18.19 (16.49)	84	130.99 (114.30)	105	179.55 (162.60)
Transport equipment & parts	-	- (-)	8	22.89 (7.04)	6	6.55 (5.12)	88	123.74 (84.84)	102	153.18 (97.00)
Electrical Machinery & appliances	-	- (-)	16	20.94 (16.12)	15	30.38 (12.66)	89	80.67 (53.94)	120	131.99 (82.72)
Machinery & accessories	-	- (-)	7	8.58 (6.97)	10	10.97 (10.92)	106	95.61 (78.14)	123	115.16 (96.03)
Electricity & gas	-	- (-)	-	- (-)	2	14.80 (13.19)	11	87.52 (42.89)	13	102.32 (56.08)
Miscellaneous Chemicals	1	0.22 (0.22)	20	26.59 (16.97)	12	15.34 (13.42)	72	41.10 (30.32)	105	83.25 (60.33)
Metal products	-	- (-)	7	10.28 (9.12)	2	5.63 (0.54)	74	62.61 (36.23)	83	78.52 (45.89)
Non-ferrous metals	-	- (-)	1	3.37 (2.59)	1	1.00 (-)	31	59.45 (47.55)	33	63.82 (50.14)
Rubber products	-	- (-)	6	8.09 (6.75)	-	- (-)	29	55.42 (45.99)	35	63.51 (52.74)
Miscellaneous non-metallic mineral products	-	- (-)	6	8.20 (5.49)	4	3.00 (2.21)	45	51.42 (36.23)	55	62.62 (43.93)
Hotel	-	- (-)	2	2.34 (0.60)	5	8.54 (7.96)	50	50.80 (43.49)	57	61.68 (52.04)
Glass and glass products	-	- (-)	6	32.93 (4.87)	-	- (-)	18	23.41 (11.07)	24	36.34 (15.94)
Miscellaneous food products	1	1.87 (1.87)	1	0.60 (0.57)	5	5.73 (2.06)	31	23.70 (15.44)	38	31.90 (19.94)
Mining	-	- (-)	2	2.51 (2.34)	5	10.80 (8.03)	6	8.44 (5.49)	13	21.75 (15.86)
Jute manufacturers	1	0.79 (0.79)	1	1.65 (1.55)	1	1.16 (1.16)	24	16.00 (12.85)	27	19.60 (16.35)
Others	1	0.20 (-)	10	11.94 (4.44)	14	9.32 (7.29)	43	39.60 (25.04)	68	61.06 (36.77)
Total :	288	336.39 (298.11)	195	457.38 (296.60)	235	351.04 (287.09)	1554	2086.86 (1497.89)	2272	3231.67 (2379.69)

* Includes Rs.2.87 crores met by IFCI under Guarantee Obligations.

INDUSTRIAL DEVELOPMENT BANK OF INDIA

Mittal Court, 'B' Wing,
224, Backbay Reclamation, Nariman Point,
Bombay 400 021

Historical Background

Traditionally, commercial banks in India, patterned on the British model of banking, confined themselves mainly to financing the working capital requirements of trade and industry. But over the years, it was increasingly realised that credit institutions could play an important role in fostering industrial development, as was shown by the experience of mixed banking in countries like Germany. This realization found concrete expression soon after the country gained political independence in August 1947. The first specialized institution for term finance for industry, viz., the Industrial Finance Corporation of India (IFCI), came into being in 1948.

The establishment of IFCI was followed by the setting up of similarly patterned regional development banks, viz., State Financial Corporations (SFCs), to operate at the State level. As a further step, for meeting the increasing financing requirements of industry, the Industrial Credit and Investment Corporation of India Limited (ICICI) was set up in 1955 with the active collaboration of the World Bank.

While the operations of all the above institutions showed steady growth and contributed substantially to the development of the economy, the rapid pace of industrialisation under India's five year plans underlined the need for a new institution with wider functions and much larger resources at its command than the existing ones. The then Finance Minister of India (Shri T. T. Krishnamachari), while introducing the Bill in the Parliament for setting up IDBI, said: "where a long term view is necessary and a certain amount of risk has to be taken, the existing institutions tend, by reasons of their statutory obligations and traditions, to be conservative and cannot in any case be very helpful. We are envisaging the new Industrial Development Bank as a central co-ordinating agency, which ultimately will be concerned, directly or indirectly, with all problems or questions relating to the long and medium term financing of industry and will be in a position, if necessary, to adopt and enforce a system of priorities, in promoting future industrial growth."

The IDBI was originally constituted as a wholly-owned subsidiary of the Reserve Bank of India (RBI), the central bank of the country, so that the new institution could benefit from the financial support, experience and authority of the central bank for effectively carrying out its tasks as the apex institution for term finance for industry. The first decade of the working of IDBI showed that it had established itself on sound lines and that it would be able to discharge its apex role even more effectively as an autonomous institution. Accordingly, the Government of India enacted in 1975 legislation for de-linking IDBI from RBI and making IDBI the "principal financial institution for co-ordinating, in conformity with national priorities, the working of institutions engaged in financing, promoting or developing industry, for assisting the development of such institutions and for providing credit and other facilities for the development of industry and for matters connected therewith." Under an Amendment Act of 1976, the ownership of IDBI was transferred from RBI to the Government of India and various responsibilities which RBI earlier had vis-a-vis industrial financing institutions in the country were vested in the reconstituted IDBI. The Act came into force effective from January 16, 1976.

Objectives and Functions

The main objective of IDBI is to serve as the apex institution for term finance for industry in India.

The Bank has been assigned a special role in (i) planning, promoting and developing industries to fill the gaps in the industrial structure in India, (ii) co-ordinating the working of institutions engaged in financing, promoting or developing industries and assisting in the development of such institutions, (iii) providing technical and administrative assistance for promotion, management or expansion of industry, and (iv) undertaking market and investment research and surveys as also techno-economic studies in connection with development of industry.

The Bank's charter provides for considerable operational flexibility. IDBI can finance all types of industries irrespective of the form of organisation or

size of the unit. Also, there are no restrictions on the nature of type of security and quantum of assistance which the Bank can provide. The forms of direct financing extended by the Bank include loans, equity participation and guarantees. Indirectly, the Bank can provide term finance to industrial concerns through refinancing of loans granted by other institutions, rediscounting machinery bills and by subscribing to the shares and bonds of eligible institutions engaged in providing term finance for industry.

The Bank is empowered to finance all types of industrial concerns engaged or to be engaged in the manufacture, processing or preservation of goods, or in mining, shipping transport, hotel industry, informatics, medical and health services and for ancillary activities taken up for small entrepreneurs, generation or distribution of power, fishing or providing shore facilities for fishing or in the maintenance, repairs, testing or servicing of machinery or vehicles, vessels, etc. or for the setting up of industrial estates. The Bank can also assist industrial concerns engaged in the research and development of any process or product or in providing special or technical knowledge or other service for the promotion of industrial growth.

Organisation and Management

The IDBI charter provides that the general superintendence, direction and management of the affairs and business of IDBI vests in a Board of Directors consisting of a Chairman and a Managing Director appointed by the Government of India (the same person could be both Chairman and Managing Director), a Deputy Governor of the Reserve Bank of India nominated by that bank and 20 other Directors (officials of the Government of India - 2, representatives of financial institutions - 5, public sector banks and SFCs - 6, employees of financial institutions - 2 and persons with special knowledge and professional experience of use to the Bank - 5), all nominated by the Central Government.

The Board has constituted an Executive Committee consisting of ten Directors including the Chairman and Managing Director. The Executive Committee is empowered to sanction financial assistance and exercise certain other powers delegated to it by the Board.

The Bank's day-to-day operations are carried on under the immediate supervision and direction of the Chairman and Managing Director assisted by Executive Directors.

The Head Office of IDBI is located in Bombay. The Bank has five Regional Offices, one each in Calcutta (Eastern Region), Madras (Southern Region), New Delhi (Northern Region), Bombay (Western Region) and Guwahati (North-Eastern Region). Regional Committees have been constituted for these five regions to

make recommendations to the Board on the special needs for the sustained industrial development of the regions. Besides, the Bank has 17 Branch Offices, one each in Agartala, Ahmedabad, Bangalore, Bhopal, Bhubaneswar, Chandigarh, Cochin, Dimapur, Gangtok, Hyderabad, Imphal, Jaipur, Jammu, Kanpur, Patna, Shillong and Shimla.

As at the end of June 1986, IDBI had 2575 employees.

Development Assistance Fund

The founders of the Bank recognised that in its capacity as the principal institution for promoting industrial growth, IDBI may be called upon to finance projects which are of vital importance for the economy but which may not be commercially attractive for financing by a bank or institution. Provision was, therefore, made in the Bank's charter for setting up a separate fund called the Development Assistance Fund (DAF) for financing such projects. Thus, the Bank considers for financing out of DAF, projects which are of strategic importance to the economy or are expected to fill up the gaps in the industrial structure but which may require assistance in a magnitude which is unusually large in relation to ordinary funds of the financial institutions or are potentially risky or involve long gestation period. The accounts and operations of DAF are kept separate from the Bank's General Fund.

Small Industries Development Fund

The need for a separate fund, specially tailored to the small sector, has been felt for some time in the context of the increasing importance of the small sector in the national economy and the expanding opportunities open to it in the immediate future. In his Budget Speech on February 28, 1986, Hon. V.P. Singh, Union Minister for Finance, announced that "... In order to provide a focal point for co-ordinating financial assistance to this sector at the apex level, it is proposed to set up a separate special fund, called the Small Industries Development Fund (SIDF) in the IDBI. This Fund will also be charged with the responsibility of providing refinancing assistance for development, expansion and modernisation of small scale industry". The SIDF will accelerate and streamline flow of assistance and also make available non-financial services commensurate with the growing volume of activity in the small scale sector. The Fund was inaugurated on May 20, 1986.

New Scheme under SIDF

With the establishment of Small Industries Development Fund, IDBI has taken a series of measures for giving a boost to the small scale sector. State Small Industries Development Corporations (SSIDCs), for the first time, are being brought within the purview of

assistance of IDBI, extent of refinance against bank loans to small scale industry sector and loan limit under Automatic Refinance Scheme are being raised, scheme of rehabilitation refinance assistance is being extended to banks and new schemes of assistance to women entrepreneurs and for quality control are being launched. The limit of assistance under the Composite Loan Scheme has been doubled from Rs.25,000 to Rs.50,000 per unit and the restriction on the population of village/town where these units need to be located for availing assistance has been raised from 50,000 to 5 lakhs. A new scheme known as Integrated Loan facility was introduced under which loans up to Rs.1 lakh per unit are extended for meeting requirements of term capital as well as working capital.

Schemes of Assistance

IDBI is currently operating the following schemes for extending assistance to industrial units and for achieving the objectives set out in its charter :

Direct Assistance

- (i) Project Finance Scheme (loans, underwriting, direct subscriptions and guarantees);
- (ii) Modernisation Assistance Scheme for all industries;
- (iii) Textile Modernisation Fund Scheme;
- (iv) Technical Development Fund Scheme; and
- (v) Equipment Finance Scheme.

Indirect Assistance

- (i) Refinance of Industrial Loans Scheme;
- (ii) Bills Rediscounting Scheme;
- (viii) Seed Capital Scheme; and
- (iv) Resource Support Scheme.

Scheme-wise Operations

Direct Assistance

IDBI's direct assistance to industrial units during 1985-86 increased by 9.8% to Rs.1,557 crores and its disbursements increased by 19.6% to Rs.873 crores. As at end June 1986, direct loan assistance of Rs.3,383 crores was outstanding. IDBI's holdings in shares and debentures of assisted companies stood at Rs.155 crores while guarantees for Rs.300 crores were in force.

Well over 95% of direct assistance to industrial projects is extended under the Project Finance Scheme. Sanctions under this Scheme to 363 projects amounted to Rs.1497 crores; of this Rs.240.5 crores were in the form of foreign currency loans. During the year, assistance sanctioned under the Technical Development Fund Scheme was significantly higher (65.8%) at Rs.38.3 crores (111 applications).

During the year, rehabilitation/modernisation assistance of Rs.27 crores was sanctioned to 31 units. The year witnessed also the full rehabilitation to

health of 38 units which were earlier taken up for nursing. As per definition adopted in the Sick Industrial Companies (Special Provisions) Act, 1985, IDBI in its portfolio has about 159 sick units involving outstanding amount of Rs.249 crores. Including Government companies, co-operatives and other companies which are outside the purview of the above definition, sick units in IDBI's portfolio aggregated 281 with outstanding loan amount of Rs.576 crores.

As a follow-up of the long term textile policy, a Nodal Agency for sick textile mills has been constituted by the Government of India to formulate and follow rehabilitation packages. The Nodal Agency has held 8 meetings so far.

Refinance Assistance

During 1985-86, IDBI sanctioned assistance of Rs.1,555 crores to 86,326 units under its Refinance Scheme - an increase of 16.7% in amount sanctioned and 8.9% in the number of units assisted over the preceding year. Disbursements under the scheme increased by 13.6% to Rs.1,092 crores. As at end of June 1986, refinance assistance of Rs.3,105 crores was outstanding. Refinance assistance sanctioned to SFCs increased by 46.6% and to SIDCs by 12.8% but that to commercial banks declined by 13.6%. The decline in refinance assistance sanctioned to banks reflected mainly the decline in bank's assistance to small road transport operators. Sanctions under the Composite Loan Scheme increased marginally from Rs.19 crores to Rs.20 crores.

Bills Rediscounting Scheme

Assistance under the Bills Rediscounting Scheme registered substantial increase of 41.8% to Rs.930 crores during 1985-86; over 70% of increase in the bills rediscounting assistance was due to larger availment of bills assistance by SEBs and SRTC's which altogether received assistance of Rs.542 crores compared to Rs.329 crores in the preceding year. Considering the special problems faced by SRTC's and SEBs, IDBI waived the 10% down payment requirement under its Bills Scheme up to June 30, 1986. This waiver had greatly facilitated larger availment of assistance by these corporations and also helped the transport manufacturing sector and electrical machinery goods which were faced with demand sluggishness.

Seed Capital Scheme

During 1985-86, sanctions under the Seed Capital Scheme aggregated Rs.15.4 crores (254 projects), compared to Rs.13.5 crores (164 projects) extended in the previous year. Disbursements aggregated Rs.12.9 crores compared to Rs.10 crores in the preceding year.

Resource Support

IDBI's resource support to other institutions by way of contribution to share capital and bonds aggregated Rs.94 crores during 1985-86.

Lending Policies and Procedures

IDBI grants financial assistance to such industries as are in conformity with the national priorities as set out in the national development plans. Besides, each individual project is appraised in regard to its technical feasibility, commercial profitability, financial soundness, economic returns and managerial competence and only such projects that satisfy the criteria laid down are assisted. Subject to these criteria, preference is given to projects in backward areas, projects promoted by new and technically qualified entrepreneurs, projects with large employment generating capacity and those which are export-oriented or import-substitutive. The main consideration in appraisal of the project is its commercial and economic viability.

Projects with capital costs up to Rs.3 crores are generally assisted indirectly by IDBI through the State level agencies/commercial banks so that IDBI concentrates only on the bigger projects for grant of direct financial assistance. Projects involving project cost of Rs.5 crores or more are generally assisted in consortium with other development banks. The amount of assistance to a single project is normally subject to the limit of 25 per cent of the paid-up capital and reserves of IDBI. Projects involving unusually high capital cost, long gestation period, low profitability and high risks, but which are of strategic importance to the economy are assisted out of the DAF.

The prime lending rate of IDBI is 14 per cent p.a. applicable for direct financial assistance to the industrial units, with special concessional rate of 12.5 per cent p.a. for new projects in backward areas (up to a ceiling limit of Rs.5 crores). The rate of interest for indirect assistance by way of refinance is 10.5 per cent p.a. allowing a reasonable margin to the primary lenders. Concessional rates on refinance assistance are allowed in the case of new projects in backward areas, small scale units, etc.

The Bank's direct loans under its Project Finance Scheme are subject to convertibility stipulation where the total amount of institutional assistance for the project exceeds Rs.5 crores. Such stipulation could provide for conversion of up to 20 per cent of the loan amount into the equity of the borrowing concern. The conversion right may be exercised any time during the currency of the loan.

Follow-up and Monitoring

IDBI, in association with the other financial institutions, has evolved a mechanism whereby one of the participating institutions acts as the 'lead' institution for appraisal of the project as well as for post-sanction follow-up. This helps the industrial units to deal with one institution only instead of all the participating

institutions. Follow-up of cases is done by (i) periodical inspections/visits, (ii) nomination of directors on the Board of Directors of the assisted units, and (iii) obtaining periodical returns about the operations of the units.

Where IDBI is not the 'lead' institution in respect of an assisted project, it keeps a close liaison with the concerned 'lead' institution in matters of follow-up.

The Bank also has arrangements for close monitoring and nursing of its assisted units which may have turned sick. Besides, the Bank helps to bring about, where necessary, changes in the management of such units or for amalgamation of such units with healthy ones.

Promotional Activities

In its role as the apex development bank of the country, IDBI undertakes a variety of promotional activities for achieving the socio-economic objectives. Such activities relate mainly to balanced regional development, creation of new classes of entrepreneurs and improvements in formulation, appraisal and implementation of projects. For these purposes, the Bank sponsors industrial potential surveys, entrepreneurship development programmes and programmes for training of personnel of development banks.

With a view to making available a variety of advisory services to entrepreneurs in the preparation of feasibility reports, choice of products and production technology, etc., IDBI, in collaboration with other all-India financial institutions, took the initiative in establishing a chain of Technical Consultancy Organisations (TCOs); so far 16 TCOs have been set up, which cover almost all the states. IDBI also publishes a Directory of Industrial Consultants.

IDBI has constituted, by transfer from its profits, a Technical Assistance Fund (TAF) for financing a wide range of developmental activities. The fund is utilised for financing (a) techno-economic surveys, (b) preparation of project profiles, feasibility studies and project reports for assessing the potentialities of regions, (c) research, (d) training facilities for the personnel of financial institutions in India and abroad for upgradation of skills, and (e) entrepreneurial development programmes (EDPs). The fund can also be utilised for any other activity which, in the opinion of IDBI, is essential for promoting industrial development.

Overall Operations

During 1985-86, sanctions of assistance under various schemes of IDBI aggregated Rs.4,175 crores; disbursements amounted to Rs.2,787 crores. Sanctions and disbursements thus recorded growth rates of 18.2% and 21.5% respectively during the year under review as compared with growth rates of 42.9% and 16.9% witnessed in the preceding year. The increase

in sanctions for 1984-85 was influenced by inclusion of large amount of assistance (Rs.440 crores) to a fertiliser project. There was no such large project in the figures of sanctions for this year; hence the disparity in the growth rates in sanctions for the two years.

Economic Benefits

IDBI's sanctions during 1985-86 are expected to catalyse investment of the order of Rs.8,500 crores and create employment opportunities for 8.5 lakh persons. Over 60% of assistance has gone to high priority industries. Almost the entire assistance was in respect of priority sector. Assistance to textiles, basic metals, chemicals, cement and transport equipment registered increases while that to fertiliser industry declined. Decline in respect of fertiliser industry was mainly due to absence of any large fertiliser unit in the sanctions for this year unlike last year.

Assistance to Backward Areas

IDBI's assistance to backward areas which mainly flows through the direct and refinance schemes amounted to Rs.1,895 crores compared to Rs.1,750 crores in the preceding year. More significantly, the number of projects directly assisted in the backward areas, increased sharply from 196 to 236 projects. IDBI also extended assistance of Rs.163 crores to 44 projects in No-Industry Districts (NIDs). This included an assistance of Rs.58 crores under the new scheme for area-specific infrastructure development projects in 25 NIDs.

Assistance sanctioned to public sector more than doubled to Rs.910 crores and its share went up to 22.5% in total sanctions from 13.1% in the preceding year.

Resources

The principal sources of funds of IDBI are (i) share capital and reserves, (ii) borrowings from Government of India and Reserve Bank of India, (iii) market borrowings by way of bonds, (iv) foreign currency borrowings, and (v) repayment of past assistance by borrowers.

During the year, Government of India subscribed further amount of Rs.30 crores to the share capital of IDBI increasing the paid-up capital to Rs.445 crores as at the end of June 1986. A loan of Rs.17 crores was received from the Government under IDA/World Bank Credit Loans. IDBI raised Rs.755 crores by issue of rupee bonds. The Reserve Bank of India allocated a limit of Rs.300 crores during 1985-86 under its NIC (LTO) Fund which was fully drawn by IDBI. During

Table 1
Scheme-wise Sanctions and Disbursements
(Rs crores)

Scheme	1984-85 July-June	1985-86	% Change
A. Sanctions			
1. Direct finance (including guarantees)	1418	1557	+ 9.8
2. Refinance	1332	1555	+ 16.7
3. Bills Rediscounting	656	930	+ 41.8
4. Others	126	133	+ 6.3
Total	3532	4175	+ 18.2
B. Disbursements			
1. Direct finance *	729	873	+ 19.6
2. Refinance	961	1092	+ 13.6
3. Bills rediscounting	495	697	+ 40.8
4. Others	108	125	+ 15.7
Total	2293	2787	+ 21.5

* Including guarantees executed.

1985-86, IDBI raised Rs.231 crores by way of foreign currency borrowings (Yen 10 billion, US \$ 20 million, Euro-dollar US \$ 25 million, DM bond issues of 100 million and US \$ 30 million by way of tax spared Revolving Underwriting Facility). IDBI received Rs.124 crores by way of deposits from companies under Companies Deposits (Surcharge on Income-tax) Scheme, 1985. IDBI received Rs.2,097 crores by way of repayment of past assistance, receipt of interest, discount, sale of investment, etc. Thus total resources available to IDBI during 1985-86 aggregated Rs.3,589 crores. Of this, a sum of Rs.3,436 crores was utilised for disbursement of assistance, repayment of borrowings, interest and dividend payments to Government of India and the year's transactions ended with a closing balance of Rs.496 crores.

NCDC

LENDs BIG SUPPORT TO SUGAR COOPERATIVES

Since 1963, the National Cooperative Development Corporation has played a pivotal role in the task of building up the country's economy through cooperatives. Its contribution to the development of cooperative sugar sector has been significant.

NCDC provides financial and technical assistance

The figures speak:

	1962-63	1985-86
Number of mills in production	41	186
Installed Capacity (Lakh tonnes)	5.51	42.80
Percentage of installed capacity in the country	22	56.34
Sugar Produced (Lakh tonnes)	4.73	41.13
Percentage of total sugar produced in the country	22	58.6

By 31.3.86 the NCDC has provided Rs. 74.251 crores for establishment of 113 new cooperative sugar mills and expansion of 6 cooperative sugar factories.

Cooperative sugar mills have been a focal point of rural development. Besides providing a fair return to the grower, they have benefited all sectors of rural population directly through employment and indirectly through the spread effects of rural industrialisation. Cooperatives have also played a leading role in socio-economic uplift through provision of medical and educational facilities.

NCDC is proud of its association with the cooperative sugar sector.



National Co-operative Development Corporation

(A Statutory Corporation)

Head Office : 4, Siri Institutional Area, Behind Hauz Khas, New Delhi - 110 016

Regional Offices : BANGALORE • CHANDIGARH • POONA
CALCUTTA • GUWAHATI • JAIPUR • LUCKNOW

Project Offices : HYDERABAD • BHUBNESHWAR • BHOPAL • PATNA
MADRAS • AHMEDABAD • SHIMLA

NATIONAL CO-OPERATIVE DEVELOPMENT CORPORATION

New Delhi
Sugar Industry Financing

Introduction

The National Cooperative Development Corporation (NCDC) was established under an Act of Parliament in 1962 to plan, promote and assist cooperative in marketing, processing and storage of agriculture produce and notified commodities. NCDC has been promoting cooperatives in such diverse fields as rural storage, sugar and spinning mills, oilseeds and cotton development and processing, handloom and fishery cooperatives, sericulture, rural consumers supplies, marketing of minor forest produce etc. With its annual budget of Rs.2.63 crores in 1961-62, the Corporation's programmes have expanded manifold to a total financial outlay of Rs. 129.11 crores in 1984-85 with a provision of Rs. 151.55 crores in 1985-86. The Corporation has already invested over Rs. 870 crores for cooperative development in the country.

Since 1978, the NCDC has been channelling funds under the World Bank (IDA) and European Economic Community (EEC) projects. The IDA assisted projects - NCDC - I and NCDC - II and one EEC Project have created facilities for rural storage, and oilseeds processing, providing the benefit of value addition to the farmers at source. NCDC - I's successful completion this year has created 8.45 lakh tonnes of storage capacity. The 3rd IDA assisted project NCDC-III with an outlay of Rs.504.44 crores also became operational from July, 1984. The project provides for storage capacity of 13.75 lakh tonnes, soyabean handling capacity of 2.4 lakh tonnes and cotton seed processing capacity of 1.4 lakh tonnes per annum. The project also has an institution building component for appropriate manpower development.

Administratively, NCDC operates through its Head Office, 7 Regional offices and 7 Project Offices all over the country. The Regional Offices function primarily as spearhead teams for identification, formulation and monitoring of projects in their jurisdiction supported by the respective Project Offices. The Head Office provides managerial and technical back up for appraisal of projects, formulation of policies

and monitoring of ongoing programmes.

Financial Role

NCDC is unique amongst the financing institutions in the country as this is the only organisation at national level which provides risk capital and margin money to cooperatives for expanding their business operations.

Besides providing funds from its own sources, the NCDC functions as a financial coordinator vis-a-vis various institutional agencies from which funds are obtained by the cooperatives for their Programmes.

A Cooperative's Way to Success

Can a primary village cooperative society running on the principle of self-help and mutual cooperation bring prosperity to a village? Can it have a working capital of Rs.128.1 lakhs with an yearly turnover of Rs.744.53 lakhs and members deposits worth Rs.102.4 lakhs? Can such a cooperative root out the mahajans from its area and cater efficiently to the credit needs of all members, agriculturists, marginal or small farmers or be it the landless labourers? How about inculcating a sense of belonging among the members, a feeling that the Society is theirs and their welfare depends upon the uplift of the Society?

A visit to the tiny picturesque hamlet Sreedharpur in Burdwan district of West Bengal brings out the creditable achievements of this Society named as the Sreedharpur Cooperative Rural Bank. And to trace its exemplary rise the members of the NCDC team had a close look at its functioning and a dialogue with the members and officials and reveal here some crucial factors for the benefit of many such cooperatives in the country.

Only Mahajan in the Area

The Society is now the only Mahajan in its area of operation of about six villages. The paradox is that its founder member a Zamindar himself, was associated with the organisation of the Burdwan District Central Cooperative Bank. He was so much inspired by the cooperative principles that he thought of organis-

ing a society in his native village, Shreedharpur. Not only did he convince the local leadership of the benefits of such a cooperative but could get the support of all strata of the society to form what it is today; The Sreedharpur Cooperative Rural Bank.

Earlier, the society was taking loan from the Central Cooperative Bank and in turn gave it to the members. But the keen financial sense of the organisers made them realise that to be able to provide better services the Society must create its own funds. The Society distributed savings boxes to the members and every Sunday the Secretary, who only had the key to the box, would go to the member and open the box in front of him, count the money and issue a receipt. The depositors were assured that they could withdraw the money, whenever they needed. Once a lady depositor had some domestic quarrel with her son, who was then the Secretary of the Society, she at once became suspicious about the safety of her deposit with the society and approached one of the directors to refund the entire amount. The total amount was immediately paid back to her. With the realisation that the society is above all quarrels, domestic or rural, she re-deposited the money. Two, three, more members also experimented by drawing out the money. But, when they saw that their deposits were safe their confidence in the society grew and it has been growing ever since. Small savings became a habit with the members and from 1939 onwards the society could independently meet the members' credit needs.

To be able to make use of the Sreedharpur Society's services, when the farmers of other nearby villages wanted to become members; the authorities had to amend the Society's bye-laws. Now it has opened branches in the six nearby villages of Mateshwar, Sankarpur, Madhyam gram, Bohar, Radhakantpur and Memari. All these branches are providing services of credit, marketing, supply of agricultural inputs, distribution of consumer items etc.

Diverse Services

The directors very soon realised that unless they extend their activities to cater to all aspects of members' economic needs, their cooperative will not get members' full support. So they opened a groceries shop to supply provisions at fair price to the villagers which has ultimately become a fullfledged consumer store. With total patronisation of the members it virtually became the controlling factor in curbing the private traders' tendency of making undue profits. Now the villagers can buy all items of their needs at the doorstep, including a good variety of cloth not only the coarse and controlled cloth but also dhoties, lungies, sarees, different blends of synthetics, dress material and cotton prints. This year the stores sold goods worth Rs.22.9 lakhs.

To solve the grave problem of landless labourers borrowing paddy at high interest rates during the sowing season, the society started 'grain-gola'. Every member purchases a share of the 'gola' valuing three mds. of paddy by contributing one md. per year. A landless labourer pays his share in six years. Thus from the stock so built up a member can get six mds. of paddy as loan during the sowing season or before harvest, to be repaid after harvest with 15 per cent interest.

For stocking the 'grain-gola' and the fertiliser the society has constructed its first godown at Sreedharpur in 1957 with a capacity of 5000 quintals. The other godown of 16,000 quintals capacity was constructed in 1967 at the Radhakantpur branch which has its office on the main road. As the feeder road to Sreedharpur is not fit for transportation particularly during monsoons, this godown now caters to the fertiliser needs of the other branches. The goodwill of the fertiliser section and the quality of stocks at the society now bring farmers from far off villages as well, to buy supplies on cash basis.

To further save the agricultural labourers from exploitation by the local mahajans the society amended its bye-laws in 1978. Now these labourer members get loans from the society against utensils at 8 per cent interest up to 80 per cent value of the utensils. They repay the loan after harvest time and get back their utensils that would never come back once in the hands of mahajans.

In 1971 the society undertook another activity for the benefit of its poor and landless members by buying a 14 acre tank for pisciculture. Two society members were trained by Fisheries Department, who now efficiently supervise the fisheries operations and the tank has provided livelihood for many poor members. Bought for Rs.33,000, it fetches an yearly income of Rs.15,000. In addition crops like paddy, potato, grams, bananas etc. are grown on the banks of the tank. The lift-irrigation system arranged by the society now waters the plots of many small farmers whose land was earlier barren as they could not lift the tank's water.

Potato Marketing

As this part of West Bengal is predominantly in the potato growing belt, first the society started marketing potato in 1974, by stocking the members produce in a hired cold store and selling at a good price. Very soon in 1978, they built their own cold storage at Shankarpur with 4000 MT capacity and extended its capacity to 9300 Mt in 1979 to meet the further demands. The farmer members bring their produce here for storage on custom basis service at a nominal rent. They get pledge loan up to the value of 60 per cent against their stocks; which the society sells when the prices

are good and pays the rest of the amount to the farmers. This cold store is so popular in the area that it is the first to get filled up. The reason being that the potato stored in this cold store has earned the reputation for its good quality and thus fetches higher prices per bag. This year their cold store earned a rent of Rs.23.64 lakhs over and above the income due to commercial purchases. The credit goes to the professional management of the operation by the society's employees. They have been particularly trained for this job by the Company which has installed the plant. And to keep their skills up-date the company's personnel periodically check these employees' efficiency.

Socio-economic Benefits

The main reason why the members feel a close affinity and a strong sense of belonging towards the society, is that the society is actively engaged in the social upliftment of the community. Long back in 1948, it founded the Sreedharpur Primary School, which has now become a higher secondary school. A new pucca building has been added in 1983. To encourage and support the talented students for higher studies the society gives a total stipend of Rs.3,500 per year to the best students of schools in its area of operation. Thus the society has so far spent nearly one lakh rupees on educational purposes.

A community centre has been established where the villagers can watch T.V. in the evenings. The local youth club, having the facility of many indoor games and the village library with about 100 books are also located in the same premises. Other social services include donation of a playground, the village post office building and creation of a charity fund out of the members' donations; who contribute to it at times by foregoing their dividend. It comes handy at times of distress like drought, floods, crop failure, etc.

For health care the society has opened a charitable Homoeopathic Dispensary and a Polio Centre. A qualified MBBS doctor paid by the society attends to the young ones free of charge.

The most important service to the villagers of course is the employment opportunities created. It has employed about 70 members, mostly the educated youth, who have been professionally trained to handle their jobs efficiently.

Special Features

-- Training of young members to take up the leadership is the unique and the most enterprising feature of this Society. Cooperative Education has always been foremost in the minds of the experienced members who teach the principles of cooperation to the young members; laying emphasis on what cooperation is not. Service and not profit earning, is the motto of cooperation.

-- The members always elect some young members in the Board. Thus there is never a dearth of future leaders with the senior and experienced hands guiding the spirit of adventurism of young blood.

-- People from different political and social backgrounds work together in this society and a change in the political leadership does not affect the society's functioning.

-- Annual General meetings are held regularly with full forum and all members are at liberty to make suggestions and criticise the activities of the retiring board. Always more than three-fourth of the total members attend such meetings and hold free and frank discussions. The members some time, come up with very touchy questions which are also answered with an objective view point. Many a time such meetings are stretched to mid-night.

-- The members elect the Board of Directors very carefully and no person can be on the Board for more than three consecutive years. A member must wait for two years to come back to the Board. Therefore, the society has never become the monopoly of a particular person or a group. All important decisions are taken with the advice of ex-Chairman, Secretaries and other veteran members. This has not only created a feeling of total involvement of the community and its leadership in the Society's affairs but has also given it a right sense of direction avoiding jealousy or negative criticism.

-- Every Sunday the Board sits to scrutinise the accounts and ascertain the day to day financial position and to examine the loan applications. In these meetings the aggrieved members can put in their grievances which are considered for a redress. The members can also write suggestions in the suggestion book any time which is perused by the Board during these weekly meetings to implement the worthy suggestions. In fact, the Society's new schemes for the tribals and landless labourers' welfare have come up based on such suggestions.

Finally, one can feel that an atmosphere has been created where all the members feel that the society is theirs and they must put in their best collective efforts to bring in success, which will ultimately mean a better life for them. With this enlightened thinking they have many more plans to take up new ventures to provide useful and suitable employment to the local educated youth on a professional basis. We wish them good luck.

STATE BANK OF INDIA

Contribution to Sugarcane Cultivation in Maharashtra

Sugarcane, Cotton and Grapes are the major commercial crops in the State of Maharashtra and these crops make notable contributions to the overall economy of the State. Over the years with the gradual increase/development of irrigation facilities, the area under sugarcane crop has expanded considerably particularly during the last fifteen years so much so the fortunes of 91 sugar factories in the State are intimately related to the growth/progress of the sugarcane cultivation. Government support, mainly through Command Area Development Programmes and Institutional Credit Support enabled the Sugar Industry to attain its unique status in the economic advancement of the State.

Cooperatives and Commercial Banks have played their respective roles creditably in this field. Initially the cooperatives enjoyed a unique position in extending credit support and controlled the major share. In the formative years Land Development Banks and District Central Cooperative Banks have provided long term investment and short term working capital credit support to agriculturists for increasing/sustaining sugarcane production. Commercial banks entered, to be precise, allowed to enter in this exclusive field of the cooperatives, rather late and justified their entry through remarkable performance. Cooperatives and commercial banks played a complementary role towards the common objective of improving the rural economy. State Bank of India, as usual occupy a leading position in supporting sugarcane cultivation among non-cooperative financing institutions.

Over 450 branches of the Bank in Maharashtra State are providing credit support to agricultural development. The main sugarcane producing areas are situated in Western Maharashtra with the largest

concentration of sugar factories. The Bank extends credit support to all the identified agricultural development programmes formulated under national policies. With the introduction of crop insurance cover to a large varieties of common crops the share of Bank's working capital assistance to crop production has increased during 1985 and is likely to register further progress in the coming years. The aggregate credit support extended by Bank's branches in Maharashtra State as at the end of June 1986 is to the tune of Rs.225 crores and the quantum of assistance provided for sugarcane development amounts to Rs.50 crores. Thus 20% of the total agricultural credit has reached the sugarcane sector in the form of long term and short term investment credit.

Broadly the credit disbursements in this particular field are as under :

- | | |
|--|---------------|
| (a) Institutional credit through State Corporations. | Rs. 10 crores |
| (b) Direct advances to Lift Irrigation Societies and individuals/groups of Agriculturists. | Rs. 10 crores |
| (c) Indirect advances through Farmers' Service Societies/Primary Agricultural Credit Societies | Rs. 2 crores |
| (d) Direct advances to individuals/groups for laying pipelines, land development farm mechanisation etc. | Rs. 14 crores |
| (e) Direct advances to individuals/groups for transport of sugarcane from fields to factories by means of bullock carts etc. | Rs. 2 crores |
| (f) Short term working capital credit requirements to agriculturists. | Rs. 12 crores |

LIFE INSURANCE CORPORATION OF INDIA

Central Office
Yogakshema, Jeevan Bima Marg,
Bombay 400 021

A Review and Financial Highlights

It was three decades ago, on September 1, 1956, the Life Insurance Corporation was formed and thus life insurance business was brought under a State owned Corporation.

The primary objective of nationalisation was to spread the message of life insurance much more widely and to make maximum mobilisation of people's savings and invest them in socially oriented schemes of the Government and other agencies.

Universally the life insurance contract is of long duration. Throughout the world people feel the need for life insurance but are invariably hesitant to make up their minds because the benefits are intangible. Naturally before purchasing life insurance, the returns from life insurance are compared with those from other funds of savings and looking at the returns of the latter, a life insurance purchase decision is often postponed. Consequently the risk elements also escape the minds.

In this context the role of life insurance Agents becomes vital as they have to approach the people individually and convince them about the benefits and necessity of having life insurance. Thus a life insurance sales person plays a steller role. An Agent who is shunned at in the first instance, is thought of as an angel if the family meets with some aforesaid situation of losing the breadwinner and being deprived of a regular income to maintain a reasonable standard of living.

Growth of life insurance in India after nationalisation is a corporate history of achievements about which the institution can be genuinely proud of as was mentioned by the then Union Finance Minister, Shri Vishwanath Pratap Singh.

The Corporation could reach a stage of commendable performance by its constant endeavour to improve not only its business performance but also other areas of operations like post-sales service to policy-holders, prudent investment of its funds having also social objectives in mind and effective claim settlements. Decentralisation of organisational functions to lower

tiers for more effective customer service and resorting to modern technologies like installation of micro processors in big size Branch Office, have brought about more effective functioning and control.

New Business Performance

The Corporation's performance and the plans for the future are to be viewed in the context of the prevailing economic climate. The Seventh Plan has set the target of growth rate of national income a little over 5 per cent per annum and gross domestic savings and the gross household savings are expected to increase annually by 6.3 per cent and 10.4 per cent respectively over this period.

There is an economic resurgence in the country and the Seventh Plan holds great promise particularly due to the present bold and pragmatic fiscal-cum-monetary policies, rationalisation of tax structure, improvement in agricultural and industrial output.

These policies of the Government are expected to be reflected in the business performance of the Corporation also. The last three financial years have recorded impressive new business performance in terms of growth. The performance of the Corporation for the year 1983-84 was Rs.4,415.28 crores which is 10.5% more than the previous year's performance. The year 1984-85 witnessed the Corporation crossing Rs.5,000 crores in terms of individual assurance. As on 31st March, 1986 the Corporation underwrote a New Business of Rs.7,088.45 crores which was 31% more than its previous year's performance. The number of policies issued by the Corporation has also recorded a consistent increase. In the year 1984-85, 27.04 lakh policies were issued as against 23.70 lakh policies for the financial year 1983-84. Whereas in the financial year 1985-86, 32.94 lakh policies have been issued. Impressive progress is also made in the Corporation's rural portfolio. In the last three years the Corporation's rural business has been Rs.1,260.24 crores, Rs.1,569.62 crores and Rs.2,176.79 crores respectively which is 28.7%, 29.2% and 30.8% of its new business respectively. Compared to the 35.19% of policies sold in rural areas in 1984-85,

in 1985-86 the number of policies sold in rural areas has shown an increase of 38.6%.

New Plans

Though life insurance is meant for risk cover primarily, the Corporation has to be alive to the changing social needs. Further, with a view to equip its sales personnel to meet the challenges and to make life insurance more attractive, the Corporation has been constantly analysing the sales feed back. On the basis of the information so received, in the year 1985 two new plans viz. 'Jeevan Saathi' and 'Jeevan Mitra' have been introduced.

Jeevan Saathi is a plan ideally suited for working couples fulfilling laid down conditions. Jeevan Mitra is a novel Double Cover Endowment plan whereunder in the event of the death of the life assured during the term of policy, an amount equal to double the amount of insurance is paid to the family. If the person survives, the insured amount is paid to him. This plan provides for high amount of family provision in the event of death of the breadwinner.

On the occasion of 30th Anniversary of the Corporation the previous Union Finance Minister Shri V. P. Singh had released three more Plans on behalf of the Corporation. One of the Plans is Temporary Life Insurance Cover for a longer duration. Under this a person's basic life insurance need is covered i.e. if a policyholder survives the terms, premiums are returned but in the event of his unfortunate death, full sum assured is paid. This Plan is named 'Bima Sandesh'. Under this Plan, throughout the terms the policyholder gets a life cover.

Next one is a Limited Payment Endowment type of Plan called 'Bhavishya Jeevan'. This Plan is ideally suited for professionals like Film Stars, Doctors, Accountants, Lawyers and also to those who go out of India temporarily for a shorter period for better prospects. Such persons have sufficiently high income during a particular period whereas at a later period income starts dwindling. For these persons a higher premium is charged during specific period and thereafter premium is charged at the reduced rates. However, the full life cover continues throughout the term of the policy. Another Plan that has been introduced is a 'New Money Back Plan' under which frequency of repayment of instalments is increased. Every 5 years the proponent will be getting the instalments which will make liquid cash available for the policyholders more frequently.

Besides these new Plans the Corporation has also reduced the premium rates for without profit policies under Endowment and Whole Life Plans.

Group Insurance Scheme

In addition to individual insurance, the Corporation offers life insurance protection and retirement benefits under Group Schemes which are in the nature of employee benefit schemes. These schemes form ideal means of achieving a better employee morale which will lead to greater productivity. These schemes provide life insurance protection at very low cost because of the economies achieved through mass administration methods.

The Corporation transacted business of Rs.8,409.90 crores under Group Insurance schemes during the year 1985-86 covering 70,33,957 lives.

We may mention here that as a matter of policy, the Corporation has, over the years, been trying to take the protection of life insurance to the weaker sections of the society through such group schemes. Among the notable group schemes transacted during 1985-86 are for the unorganised workers in Tamil Nadu like small and marginal farmers, building construction workers, loading and unloading workers, hand cart pullers, washermen, masons and many others and also farmers in Madhya Pradesh through agricultural co-operatives and municipal sweepers and railway porters through their registered unions. Apart from a few schemes cited here the Corporation has offered life insurance protection to many groups belonging to the economically weaker sections. In 1985-86, 225 schemes covering 3,24,074 people were finalised for the weaker sections.

Bonus

Since its formation the Corporation has been declaring higher and higher bonus to its policyholders due to prudent management of its funds. Last year the Corporation has declared an all-time high bonus of Rs.55/- per thousand sum assured per year on its with profits Whole Life policies and Rs.44/- per thousand sum assured per year on its with Profit Endowment policies on the basis of fifteenth valuation of its Assets and Liabilities as on 31st March, 1985.

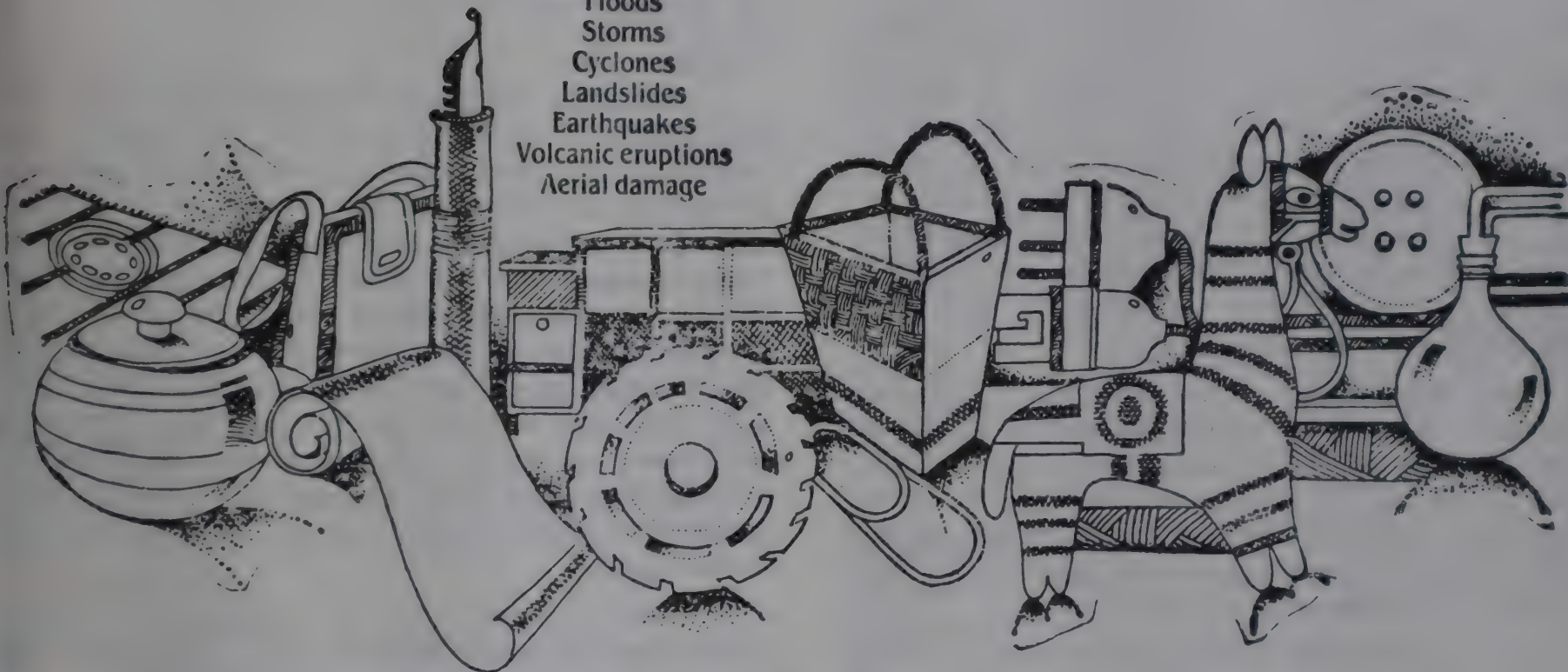
Statutorily the next valuation is to be done on the basis of the Assets & Liabilities of the Corporation as at 31st March, 1987 only but to commemorate the 30th Anniversary of the Corporation, a special valuation was done as on 31st March, 1986 and all the policyholders whose participating policies were in force as on 31st March, 1986 now get an increased bonus for the year 1986-87 by way of 30th Anniversary bonus. The bonus rates will be Rs.44/- plus Rs.8/- i.e. Rs.52/- per thousand for Endowment policies and Rs.55/- plus Rs.10/- i.e. Rs.65/- per thousand for Whole Time policies per year and, thus, within an year's time the Corporation has benefitted its policyholders by increasing the bonus rates substantially.

In addition to this Record Bonuses the Corporation

Here are 13 reasons why every small scale industry should take the new Fire Insurance Policy

Risks like:

Fire
Lightning
Riots
Strikes
Malicious damage
Explosions
Floods
Storms
Cyclones
Landslides
Earthquakes
Volcanic eruptions
Aerial damage



Here is one weighty reason why even
the tiniest industry can afford it:

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you pay as little as One rupee for a
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AGION/86

gives a Final (Additional) Bonus for Whole Life and Endowment policies, whereunder claims by maturity/death occur after at least 15 yearly premiums have been paid. This terminal bonus ranges from Rs.45/- per thousand sum assured to Rs.190/- per thousand sum assured depending on the number of years premiums paid.

Claim Settlement Operations

The Corporation's efforts to decentralise functions is reflected in its claim settlement operations. Apart from the decentralisation of settlement of claims up to certain extent to the branches, liberalisation has also been made in certain procedures so that claim settlements could be expedited and the claimants will have lesser formalities to comply with now. For instance, decisions have already been taken for waiving proof of age up to certain limit and settlement of claims up to certain sum assured on the basis of indemnity bonds where the original policy is lost. As on 31st March, 1986 the Corporation had an outstanding claim of around 6.75% as against the previous year's figures of 8.29% (by number) and approximately 8.36% as against 10.29% (by amount).

The percentage of outstanding claims has been steadily going down for the last four years mainly due to the decentralisation of operations and constant monitoring of claims settlement performance of the subordinate offices. This percentage of the Corporation compares favourably with some of the leading insurance companies of the Western countries.

It may also be mentioned here that during 1985-86 over 54% percent of Maturity Claims have been settled on or before the date of maturity as against 48% during the previous year. Further, over 71% Death Claims have been settled within three months as against 67% during the previous year.

Investments

In keeping with the Government policy, substantial support is being given by investments in Central and State Government Securities and in the socially purposive sector. As at 31.3.1986 the Corporation had invested Rs.1,748.00 crores in Electricity, Rs.1,302.00 crores in Housing and Rs.548.00 crores in Water Supply and Sewerage schemes.

As on 31st March, 1986 the book value of the Corporation's investments stood at Rs.12,264 crores as against Rs.10,804 crores in the previous year. The book value of investments in the socially purposive sector as on 31st March, 1986 was Rs.5,780 crores as against Rs.5,269 crores as on 31st March, 1985 and Rs.4,713 crores as on 31st March, 1984. Including Investment in Government Securities, Corporations Investment in Socially Oriented Sectors as on 31st March, 1986 is Rs.10,067.87 crores.

Income

During 1985-86 the Corporation's income has also shown substantial improvement. During this year the Corporation's income rose by 16.72% as against 15.96% of the previous year. The Corporation's income in 1985-86 was Rs.2941.31 crores from various sources as against Rs.2,519.99 crores of 1984-85.

Expenses

Another encouraging factor is that the Corporation's costs are under control. In 1985-86 the favourable trend of effective control on the renewal expense ratio continued. This year the renewal expenses ratio has gone down to 12.49% compared to 13.07% of the previous year.

Grievance Cell

In spite of the fall in the outstanding claims ratio and general improvement in the servicing, it was considered necessary to focus attention on the individual grievances and in order to mitigate the hardships to individuals, a Grievance Cell has been organised in the Zonal Headquarters with under the charge of a Senior Officer. Apart from naming such a Senior Officer in the Zones, steps have also been taken to ensure that the Branch Manager is personally available once every week to meet any one with a problem concerning settlement of claim. Branches and the Divisional Offices have been given suitable guidelines to periodically notify the public through the regional press in this regard.

With the objective of rendering still better service to the policyholders, the Corporation has declared its 30th Anniversary year (1986-87) as the "Year of the Policyholder".

Reorganisation and Decentralisation of Functions

Since its inception the Corporation has been taking various measures to improve its service to the policyholders and one of the steps taken recently is to decentralise various functions to the lower formations in the Corporation and make the branch offices profit-oriented and self-reliant. With this objective in view, a massive programme of decentralisation of functions has been resorted to by (i) decentralisation of servicing functions to Branches, (ii) installing micro processors at bigger Branches for better efficiency and (iii) assigning controls and supervisory functions of Branches to the Divisions.

This programme was initiated on a time-bound basis with the full co-operation of the employees, agents and development officers. Under the programme of switching over to micro processors systems have already been installed at the Divisions and large size branches. Shortly, remaining large Branches are also to be covered. The feed back received by the Corporation indicates that there is a significant improve-

ment in the overall efficiency of its offices.

Under the reorganisation set-up the Central Office will be vested with the responsibility of making policies, strategic planning, developing expertise, conducting research and evolving performance review and indicators. There will be yearly planning in respect of all aspects of activities on the basis of guidelines issued and the performance budgets will be approved by Central Office. The Zonal Offices will have the responsibility of terminal decisions on operational matters and also develop strategies consistent with the characteristics of the region with an over-all responsibility for in-put control. The Divisions will have control on the Branches and the Branches will be the primary centres for policyholders and agents.

Publicity Activities

The Corporation's publicity activities are also getting a new orientation in conformity with the role it is destined to play. Now the publicity efforts are more towards customer education, canvassing life insurance as a basic security, enlightening the public on human life value, investment of people's money for People's Welfare etc. To achieve this, a National Publicity Seminar was organised where for the first time the Advertising Agencies from the various areas were given an opportunity to meet and discuss with the officers from the Zonal, Divisional and Branch Offices and understand their publicity needs so that the agencies will be in a better position to render publicity services to the Corporation.

Opening of Offices

The total number of Branch Offices now stand at 1197. In 1985-86, 90 new Branch Offices were opened as against 84 offices branch in the previous year. The Corporation is opening 15 Divisional Offices in the current year, raising the strength to 58 - throughout the country.

Plans for the Future

For the last three years the Corporation has introduced a system of Planning and Performance

Budgeting. Under this the branches have to prepare yearly Performance Plans and Budget on the basis of their socio-economic environment. The Divisional and Zonal Offices are required to play the role of supporting offices for the branches in achieving their plans. Two primary aspects of the planning are the data-based discussion for higher and lower offices and mutual agreement for achieving the targets and producing the results.

For the purpose of corporate performance in various areas, the Chairman laid down a plan covering a period of next five years. For the year 1985-86 the Corporation had originally targeted a new business of Rs.6,560 crores. During the course of the year when the performance was reviewed it was found that there was adequate potential to exceed this figure and, as such, the target was revised to Rs.6,829 crores but when the books closed for the year the Corporation's new business was Rs.7,088.45 crores, which is 31% increase over the previous year's business. Normally, based on the original trend, the Corporation's target for the financial year 1986-87 should have been Rs.8,200 crores. However, as the Corporation wanted to show an impressive improvement in its new business portfolio, the target has now been fixed as Rs.9,000 crores. On the basis of this plan the new business is expected to cross Rs.15,500 crores by 1989-90.

The number of policies is also to show a similar increase and the target is to achieve 51.30 lakhs of policies by 1989-90. At present the Corporation has a total Life Insurance Business in force of more than Rs.52,381 crores under 281 lakh policies. It is expected that the Corporation's business in force by 1989-90 will be Rs.59,100 crores under 348.12 lakh policies.

Thus, the Corporation is endeavouring to excel in all its areas of operations. In our future planning, the policyholder is going to be the centre of all our activities and on the occasion of its 30th Anniversary, the Corporation rededicates itself to the service of its ever-increasing policyholders and the Nation.

DHULIA DIST CENTRAL CO-OP. BANK LTD.

Garud Baug, DHULE (Maharashtra)

Tel: 136, 453, 358

Gram: SAHAKARBANK

Dhule District Central Cooperative Bank has 99 branches, serving the people of the district. The Bank aims at serving the rural poor and backward people and to make them happy and prosperous. It is the leading bank in the district helping the landless and small landholders. The depositors have been paid attractive interest, which has earned continued confidence of the depositors. Safe Deposit lockers

have been made available in some branches while the Janata Accident Insurance Policy Scheme is operated by the Bank. Some of the branches also offer loan against gold/silver ornaments. The Bank is a leading Bank in Maharashtra, implementing the Crop Insurance Scheme. It also provides loan facilities against Projects.

The people of Dhule have been offered a special facility of banking services upto 7 p.m.

MAHARASHTRA STATE FINANCIAL CORPORATION

New Excelsior Building,
A. K. Naik Marg, Bombay 400 001

Maharashtra State Financial Corporation (MSFC) has entered into its Silver Jubilee Year on 14th August, 1986. Since its inception in 1962, the Corporation has played a vital role in the industrialisation of the State. Its cumulative sanctions in Maharashtra and Goa have gone up to Rs.575 crores from a mere Rs.2 crores in 1962. The amount disbursed aggregated to about Rs.375 crores by the end of March 1986. The Corporation is estimated to have catalysed investment to the tune of Rs.1200 crores and provided employment opportunities to about 6.5 lakh persons in the State.

The two focal points of the Corporation's activities have been encouraging Small Scale Sector and promoting industries in the developing and backward areas of the State. The Corporation has concentrated its efforts in this direction and out of its total sanctions nearly 75% have gone to Small Scale Sector; and assistance to the industries in developing and backward areas has also been about 70%.

Recently, the Corporation has introduced an "Equipment Finance" Scheme with a view to enabling the entrepreneurs to acquire new additional modern equipments for the purpose of expansion, modernisation, pollution control, energy saving etc. Under the scheme quick financial assistance is made available to the entrepreneurs on attractive terms.

Similarly, the Corporation has been providing assistance in the form of Seed Capital to the deserving entrepreneurs at the nominal interest of 1% upto Rs.2 lakhs. Recently, as per IDBI's directives, the limit of its assistance has been enhanced from Rs.2 lakhs to Rs.4 lakhs.

To provide comprehensive and varied information and guidance, especially to the new entrepreneurs, the Corporation has, in the past, undertaken entrepreneurial development programme at the various Districts in the State. The idea of these programmes is to encourage the new entrepreneurs to come forward to set up industries in various regions. Such EDP programmes are now proposed to be brought under one umbrella. The Corporation would continue to play its role in consonance with the Government policy.

In order to make financial assistance available to the entrepreneurs in time and to enable them to complete their projects as per the schedule, the Corporation has introduced time-bound programme for the clearance of the loan applications. With this in view, the Corporation has set up a separate Cell under the direct supervision of Senior Officers to screen the proposals at the initial stage and to suggest to the entrepreneurs various improvements in the proposals and to provide them necessary information and guidance. This helps the entrepreneurs to avoid delay in submission of required information and documents etc.

In order to extend more efficient services to the entrepreneurs, the Corporation has introduced a number of procedural changes and further administrative reforms are on the anvil. It is the earnest desire of the Corporation to make its functioning more professional and its operations more service oriented. This is proposed to be achieved by administrative reorganisation and better training to the staff and executives.

To take cognizance of the various difficulties faced by the entrepreneurs in availing financial assistance and in implementing their projects, the Corporation has recently set up a Grievances Redressal Cell at its Head Office. The entrepreneurs can now bring their grievances to the notice of the Managing Director through this Cell.

The Corporation is concerned about the increasing sickness in the industries. The Corporation of course thinks that the units assisted by it are national assets and as such, no unit should remain unproductive. The Corporation has drawn an action plan to identify the causes of sickness and unsatisfactory performance of the assisted units. Vigorous steps like change in Management, providing necessary reliefs are being taken. Further, the Corporation has introduced a system of regular inspections of units assisted by it to watch their performance.

It has been its experience that new units face problems of securing adequate Working Capital from the commercial banks. In order to solve this difficulty, the Corporation has introduced a system of weekly meetings with the various Banking Institutions. Similarly

contacts are also maintained with the Banks at regional level. The Corporation is also making efforts to ensure availability of adequate Working Capital and Cash Credit accommodation to the units facing difficulties.

In its emphasis to assist the small scale entre-

preneur, its efforts are purposefully moving towards ensuring rapid and sustained progress of the developing and backward areas, and the Corporation would vigorously continue its developmental role in the years to come.

NASIK DIST. CENTRAL CO-OP BANK LTD.

In view of adoption of three-tier loan system in the Cooperative sector, the then Revenue Minister, late Shri Bhausaheb Hirey founded the Bank on 26th January, 1955.

The Bank is serving Nasik District with 171 branches spread in the district, including 32 branches in tribal areas.

The Bank has following objectives :

1. to bank and deal with the cooperative societies in the district.
2. to assist the capital of the associated cooperative societies
3. to help establishment and development of cooperative societies in the district
4. to distribute loans to the needy persons against gold/silver ornaments/Government Bonds/fixed deposit receipts/small saving certificates etc.
5. To help bank employees to establish funds/trusts and cooperative housing schemes
6. to carry out business of banking.

The Bank also overseas the farmers cooperative societies for distribution of crop loans. The Bank is committed to see that allocated portion reaches the small land holders and has made concerted efforts towards the same.

In accordance with rural development and development programme of drought prone areas, the Bank is making all possible efforts to help the

small landholders and economically backward with concessional interest schemes, and to assist maximum possible members.

Seven Talukas of the District fall in the tribal area and there are 46 tribal societies in the area. To help distribution of loans to the societies the Bank has formed a tribal sub-committee and extended loan as per their needs.

The Bank has extended loan facility to the member-societies for farming, electric motors, oil engines, wells, pipes, tractors etc. in addition to help farmers build their houses. Since NABARD has agreed to provide loan facilities on long-term basis for lift irrigation schemes, 6 such schemes have been given loan of Rs.613.69 lakhs.

The Bank is also active in extending easy loan facility under the 20-Point Programme.

Non-agricultural societies have also been assisted with the required loans by the Bank. Also cooperative sugar factories, cooperative spinning and cooperative milk societies have been helped with cash credit limits.

The cooperative housing societies have also been provided with bridge finance facilities.

The members who repay the loans regularly and in time, have been given rebates in the interest. The Bank is thus attempting its best to help development of the cooperative societies of the district.

Heartfelt Good Wishes

from

**NASIK ZILLA MADHYAVARTI SAHAKARI
BANK
LTD.
NASIK**

Central Offices : Nasik, Chandwad, Dabhadi, Yeola, Nasik Road & Kalvan
with uptodate locker arrangements

We are there to serve you in respect of every type of Banking Transaction
along with our 173 Branches

Various attractive Deposit Schemes for
your Current, Savings and future
financial needs.

Ambadas Balaji Bankar
Vice-Chairman

Shankarrao Mukaji Ipar
Chairman

Board of Directors

Tukaram Shankar Pawar
Motiram Hari Patil
Ganpatrao Gangadhar Patil
Malojirao Sadashiv Mogal
Kisanrao Nathuji Chavanke
Yeshwant Mahadu Bhoys
Pralhadrao Namdev Karad
Laxman Vedu Patil
Hari Shankar Mahale
Gangadhar Narayan Shinde
Y. D. Khavale (Dist. Dy. Registrar)
M. L. Patil

Jaywantrao Chindhuji Sawant
Bhanwarlal Bansilal Sharma
Sampatrao Dajiba Patil
Uttamrao Nathuji Dhikale
Gopalrao Raolaji Gulve
Sitaram Bhagwat Holkar
Hukumchand Chunilal Bagmar
Madhukar Baburao Bhalerao
Vishwasrao Namdev Deore
M. K. Firodia
T. Z. Pawar (President, Zilla Parishad)
S. G. Marwadi

P. S. Dere, B.A.(Hons), H.D.C., D.C.B.M.
Manager

THE MAHARASHTRA STATE CO-OPERATIVE BANK LIMITED BOMBAY

9, Nagindas Master Road (Extension),
Fort, Bombay 400 023

The Maharashtra State Cooperative Bank was established in 1911. It has completed seven decades of its notable role as leader of the cooperative movement of the State. A radical transformation of political, social and economic structure has taken place during the period-in tune with this change on the national scene; the face of the cooperative movement has also changed radically.

Out of the experiment to create primary credit societies as a help to the weak has grown a fairly strong and well-knit three tiered cooperative credit structure to provide powerful support to the non-credit structure embracing a wide field of economic activity ranging from production, marketing and processing of agricultural produce to the manufacture of inputs for agriculture and the service to the consumers, while serving the weak, backward, the depressed people.

In this national endeavour for fostering all-round development of the cooperative sector, the Maharashtra State has always played a prominent role and has largely provided the lead. In many instances, this has been the result of the vision, guidance and organising capacity that the MSC Bank could command. The leadership, it could mobilise in the rural areas for ground work, and the support from the Government and the Reserve Bank, each deriving the strength from the other links and injecting its own into them, has proved rewarding in moving forward in step with each other without being overtaken by sharp swings of political, social and economic tides.

Panoramic View

Maharashtra is considered to be a cooperatively well-developed State in the country. Beginning with credit both for agricultural and non-agricultural purposes, the cooperative endeavour has gradually fanned out to more and more activities and included in its fold different segments of the rural and urban population. There is hardly any village in the State which is not served by a cooperative and hardly any important economic activity which is not undertaken on cooperative basis.

The Cooperative kaleidoscope of the state presents an astonishing galaxy of about 64,200 societies-banks and credit societies for agricultural and other pursuits, the farming and lift irrigation societies securing for the small cultivators the economies of joint operation on a large scale, the marketing societies ensuring for the farmers timely and adequate supplies of their requirements and a due price for their produce; processing cooperatives like rice mills and solvent extraction plants, cotton ginning and pressing societies and spinning mills and notably the sugar factories, which have emerged as the nuclei of decentralised agro-economic development and act as catalytic agents in the socio-economic transformation in rural areas; the highly sophisticated gigantic projects for the production of agricultural inputs like fertilisers and machinery and implements like oil engines and pump sets, tractor and tillers, with fruitful foreign collaboration where necessary; and lots of other cooperatives like artisans' and consumers societies, dairy, poultry, piggery, fishery, labour contract, forest labour etc. which are primarily aimed at providing assistance and relief to the worker and vulnerable elements in the society.

Genesis

The Maharashtra State Cooperative Bank has played a significant role in initiating and ensuring an enviable growth and development of cooperative effort in the State.

Established on October 11, 1911 by a special resolution of the then Government of Bombay, the Bank started business by taking over from Government the provision of finance to agriculturists at cheaper rate of interest under the Government Scheme of teccavi loans. After a period of about two decades of smooth sailing, it had to face serious difficulties in the thirties when it was confronted by a panicky demand for withdrawal of deposits. The Bank could, however, successfully weather the storm more or less from its own resources and emerged even stronger than before. Then came World War II which brought stability to agricultural prices and enabled the Bank further to consolidate its position. The emphasis, encouragement and State assistance earned by cooperation in the post-indepen-

dence years, and the bold approach and progressive policies followed by the Bank resulted in its continued progress and prosperity.

Non Official Leadership

But more important than the quantitative progress is the basic approach inherent in the activities and aspirations of the bank over all these years.

The singular factor which differentiates cooperative developments in Maharashtra from those in other States is the fact that from the very beginning, the Bank was fortunate in having at the helm of affairs eminent personalities in different walks of life.

Successful businessmen like Sarvashri V. D. Thackersey, C. V. Mehta, Lallubhai Samaldas and R. G. Saraiya; intellectuals of repute like Prof. D. G. Karve, Prof. D. R. Gadgil, and respected, devoted cooperative workers like Shri V. L. Mehta, Shri G. K. Deodhar, Shri V. P. Varde and Shri Y. G. Gaitonde were associated with the Bank either as Chairman or Chief Executives. This resulted in non-official leadership inspiring a happy fusion of business acumen with social sympathy. This has left an indelible imprint on the character and accomplishments of the cooperative movement of the State, and has ensured large scale participation from the masses, which is the very soul of cooperative activity.

This concept of people's participation was nursed by the Bank in its early history when it operated branches in the districts by constitution of branch committees and giving them some of the powers of the Board. This provided the nucleus of trained leadership for the district central cooperative banks which were formed subsequently and the Bank could withdraw from the districts by handing over the business to the newly formed banks.

Integrated Working

Cooperation amongst cooperatives has been another important feature of the working of the cooperatives in the State. This has been facilitated by leadership provided by the Bank. It started by establishing direct contact with the cultivators but later closed its branches by encouraging formation of district central cooperative banks. Similarly in the initial stages it combined credit and marketing in its rural branches. However, in course of time it encouraged formation of separate marketing societies and transferred this business to these newly formed societies.

In more recent years the apex and the district banks and the marketing and processing societies working at different levels jointly operated Monopoly Procurement Scheme for foodgrains and for cotton and provided an object lesson of socialisation of trade in agricultural commodities.

Agro-Industries

It was through the efforts of the MSC Bank that the first cooperative sugar factory was established in the State in 1950. Successful operation of this factory gave impetus to the organisation of growers' cooperatives for the processing of agricultural products. In fact, in the Second Five Year Plan period a policy decision was taken to license any further capacity in agricultural processing industries only in the cooperative sector.

The Bank not only finance to the agricultural processing industries but also offers them guidance and assistance in promotional, technical and managerial matters. For this purpose it constituted a Cooperative Industries Commission as a separate Cell within the Bank consisting of experts drawn from Universities and technical institutes, industrial houses and consultancy organisations.

The Bank did not stop at agricultural processing industries alone. It encouraged cooperative industries for production of agricultural inputs like fertilisers, agricultural implements like oil engines, pump sets, tractors and tillers etc. and also for undertaking secondary and tertiary industries like manufacture of paper, alcohol, paints and varnishes etc. by utilising by-products of the agricultural processing industries.

Consortium Financing

With the expanding dimensions of the cooperative activities it had to face new challenges in its role as the balancing centre of the cooperative movement in the State. At one time, faced with the problem of surplus resources, it had to explore the possibility of finding new avenues like national level cooperative organisations such as the IFFCO and NCDC; and corporate bodies like Agro Industrial Development Corporations. This approach of the Bank culminated in appointment of a special working group on deployment of resources of the state and central cooperative banks by the RBI and acceptance of this approach as an all-India policy.

Weaker Sections

Cooperation is basically meant for the economically weak who come together to satisfy their common economic needs through associative action. Cooperative banks in the State have always recognised their responsibility towards the weaker sections. Under the guidance and inspiration of the apex bank they have been showing increasing initiative in undertaking schemes specifically meant to benefit small farmers, agricultural and other labourers, artisans, small traders and the like.

The Bank sponsored an experiment, with the help of district central cooperative banks, in providing full finance in a systematic and supervised manner, for all requirements of the small farmers and production

as well as consumption. It has also constituted a special credit stabilisation fund and organised provision of funds to the fishery societies on the same lines as those of crop loans, on easy terms. It has also rendered special assistance to labourers' and hawkers' cooperatives in Greater Bombay District.

With a view to helping the rural artisans, the Government, in collaboration with the Khadi and Village Industries Board has undertaken an ambitious programme of organising about 300 block level societies. The cooperative banks in the State have assumed the responsibility of providing them adequate block and working capital, with financial support from the Khadi Board and the Reserve Bank of India.

Banking Services

The Bank has also been a pioneer in introducing several banking facilities and services for its customers. It has been providing remittance and clearing house facilities by becoming a member of the Bombay Bankers' Clearing House in 1930 and by devising the Mutual Arrangements Scheme in 1931. It was the first apex cooperative bank to be admitted to a clearing house and today it is regarded as one of the important members of the Bombay Bankers' Clearing House.

The Mutual Arrangement Scheme for cooperative banks in the State enthused the National Federation of State Cooperative Banks to introduce a similar scheme for cooperative banks in the country from the sixties.

Widespread Network

The Bank has always emphasised working by establishing direct contacts with the villages. In the initial period it started by establishing its own branches in far-off places in the State. However, with the acceptance of the three-tiered cooperative credit structure, in the post-rural credit survey period in the late fifties, the Bank seized the initiative in organising the district central cooperative banks even by closing its branches and transferring their business to the newly created central financing agencies and also encouraged a healthy development of the urban cooperative banks.

The widespread net-work of banking organisation in the State and dimensions of their operations would become clear from the following information :

particulars	State Coop. Banks	Dist. Cent. Banks	Primary (Urban) Coop. Banks	Primary Agril. Credit Societies
A. MAHARASHTRA (30.6.1985)				
1. Number	1	29	362	18368
2. No.of branches (incl. H.O.)	43	2321	-	-
3. Membership (in thousands)	20	69	2600	5950
4. Owned Funds (Rs.in Crores)	136.08	154.08	159.50	204.80
5. Deposits (Rs. in Crores)	960.98	124.76	1460.00	16.00
6. Advances Outstanding (Rs. in Crores)	611.25	951.24	928.00	622.00
7. Working Capital	1180.06	1668.18	17.50	810.00
B. INDIA (30.6.1985)				
1. Number	27	337	1064	94592
2. No. of Offices (incl. H.O.)	408	7275	-	-
3. Membership (in thousands)	23	277	5369	54836
4. Owned funds (Rs. in Crores)	301	601	149	687
5. Deposits (Rs. in Crores)	1424	1978	340	250
6. Advances Outstanding (Rs. in Crores)	1410	2611	741	2374
7. Working Capital (Rs. in Crores)	2275	3870	1279	3577

New Scheme

The Bank is always on the look out for new avenues and new strategies, in tune with the challenges and opportunities of the situation. With a view to realise the full potential of the agricultural productivity and to achieve the objective of helping the poor and the weak, the Bank has now been emphasising provision of credit at special rates for the following activities.

1. Farm mechanisation, particularly the purchase of tractors and threshers;
2. Minor irrigation projects and modern irrigation systems like sprinkler and drip irrigation;
3. Fish farming;

4. Social forestry by encouraging the plantation of the wonder tree "Subabul";
5. Farm house-cum-cattle sheds;
6. Purchase of milch-cattle by small farmers and landless labourers;
7. Interest-free loans to small farmers holding dry land upto 7.5 acres for purchase of shares of Cooperative Spinning Mills;
8. Revolving cash credit system in place of the crop loan system;
9. Sericultural Scheme in Konkan.

A Pioneer

This brief resume will indicate that the initiative and enthusiasm of the non-official leadership and the well-knit integrated working of the cooperative institutions in the State has enabled the MSC Bank to remain in the forefront in the development of cooperative ideology and activity. The Bank has not only achieved phenomenal progress in its traditional activities but has also been responsible for initiating significant developments in cooperative thought and policy resulting in consolidation and diversification of cooperative effort.

New developments in cooperation are initiated in the State and after their successful operation here, they spread to other parts of the country. The Crop Loan System of financing agriculture, State participation in the share capital of cooperatives, sugar cooperatives as forerunners of the producers cooperatives, monopoly procurement scheme for foodgrains and Cotton, Co-operative Industries Commission, annual conferences of CFAs, as the annual credit planning exercise, the Mutual Arrangement Scheme for cooperative banks - these are some of the more important instances of the pioneering spirit.

A Development Bank

These achievements are by no means accidental; they are the result of well-conceived policies pursued consistently over decades in a spirit of innovation and experimentation. The boldness to accept new challenges and take up the accompanying risks has been the characteristic feature of the working of the Bank over its entire career of the past seven decades.

It has been working as a true Development Bank. It is therefore, no wonder that the Bank has earned for itself a pivotal role in the cooperative movement and is today regarded as the largest and the strongest State Cooperative Bank in the country.

Business Expansion

The dimensions of the financial progress of the Bank over seven decades of its existence can be gauged from the following figures :

(Rs. in lakhs)

Year ended 30th June	Capital & Reserves	Total Deposits	Total Resources	Loans Outstanding
1912	2.00	3.00	6.00	5.00
1922	9.00	46.00	67.00	51.00
1932	20.00	129.00	173.00	99.00
1942	33.00	235.00	289.00	96.00
1952	98.46	745.81	1217.61	649.24
1962	493.27	2548.41	6161.63	4540.37
1967	1185.87	5095.66	10665.96	7651.31
1970	1631.77	8115.48	17091.46	12939.89
1971	1885.06	9332.36	19575.35	14189.93
1972	2068.20	10422.65	20468.42	14849.88
1975	3305.42	16251.51	32276.64	23368.82
1976	3730.41	22491.86	36311.44	22446.46
1977	4545.52	23023.05	33523.55	17789.40
1978	5312.50	25996.03	39421.00	27116.16
1979	5587.50	32227.75	44518.05	28751.50
1980	6535.18	35824.74	47086.30	24564.67
1981	7334.00	42993.81	55582.27	31075.62
1982	8684.00	52530.00	70097.00	50084.00
1983	10996.00	62374.00	85376.00	61212.00
1984	12414.00	82337.00	101849.00	46361.00
1985	13568.00	95975.00	119190.00	61125.00

WESTERN MAHARASHTRA DEVELOPMENT CORPORATION LTD.

2nd Floor, Kubera Chambers,
Dr. Rajendra Prasad Road,
Pune 411 005 Tel: 50912

The Western Maharashtra Development Corporation Limited was incorporated on 3rd December 1970 with the objectives of promoting, encouraging and assisting an orderly establishment, growth and development of industries and industrialisation in the districts of Pune, Sangli, Satara, Solapur, Kolhapur, Dhule Nasik, Jalgaon and Ahmednagar. The authorised Share Capital is of Rs.500 lacs and Paid Up Capital is Rs.277.87 lacs. During the financial year ended on 31.3.1986, net profits of WMDC are Rs.147.59 lacs (before tax) and the Board of WMDC has declared a maiden dividend of 5% (Rs.13.90 lacs) for the year ended on 31.3.1986. WMDC is the first among the 4 Regional Development Corporations set up by Government of Maharashtra who has declared dividend. Not only WMDC, but also one of its subsidiary Abhijat Samayadarshika (Maharashtra) Limited, Kolhapur, which is assembling HMT watches, has declared a maiden dividend of 5% (Rs.62,500/-) for the year 1985.

Some of the major activities of the Corporation are highlighted as follows :

(A) Implementation of Government Schemes

1. Employment Promotion Programme

This Corporation is implementing this Scheme since 1972-73 and under this Scheme, educated unemployed persons are provided with Seed Capital assistance as per the norms laid down by the Government to the tune of 10-22-1/2% of the Project Cost, subject to a maximum of Rs.1 lac. Under this Scheme as on 31.3.1986, the Corporation has assisted 25,989 entrepreneurs and has disbursed loan to the tune of Rs.1665.14 lacs. This Scheme has resulted in providing employment to about 56,000 persons.

2. Package Scheme of Incentives

The Government of Maharashtra has transferred the implementation of Package Scheme of Incentives to this Corporation for releasing various Incentives offered under the Scheme to the small scale industries

namely, Special Capital Incentive, Sales Tax and Octroi Incentive etc. Presently under the P.S.I., the Corporation is implementing 1976, 1979 and 1983 Schemes. As on 31.3.1986, the Corporation has disbursed an amount of Rs.852.47 lacs under P.S.I. and about 1260 units have taken advantage of the Scheme.

(B) Equity Participation Scheme

The Corporation participates in the equity of the Industrial enterprises in case industrial venture falls short of actual equity required as per the norms of financial institutions. As on 31.3.1986 investment in the equity of the companies is Rs.30.28 lacs in 21 companies. In some of the companies where the Corporation has invested by way of equity, these companies have declared dividends and performance of some of the companies is quite encouraging. The Corporation has received good response under this Scheme.

(C) Projects under Implementation

1. Distillery Division

The Government of Maharashtra on 1.1.1977 has transferred the Government Distillery at Chitali, Dist. Ahmednagar, to WMDC. This distillery is mainly producing Industrial Alcohol and Country Liquor. As on 31.3.1986, WMDC's investment in this distillery is Rs.118.63 lacs and about 217 workers are employed. The production capacity of this distillery is of 150 lac B.L. of Industrial Alcohol p.a. and 17.25 lac B.L. of Country Liquor p.a. During the year 1985-86, the distillery has manufactured 112.49 lac B.L. of Industrial Alcohol and 17.41 lac B.L. of Country Liquor. During the year 1985-86, the distillery has earned profits of Rs.199.51 lacs (before taxation). The turnover of the same year is Rs.423 lacs.

In order to overcome with the problems of pollution arising out of spent wash which comes from the distillery, the Corporation along with M/s Thermax India Ltd., has undertaken a Pilot Project for the same and set up an Effluent Treatment Plant (on

experimental basis). This would be one of the first of its kind in the country.

2. WMDC's Subsidiary

The Corporation has set up a subsidiary company named as Abhijit Samayadarshika (Maharashtra) Ltd. in June 1978 with the technical assistance from H.M.T., Bangalore, to assemble HMT watches. The production capacity of this unit is 3.5 lacs watches per year and as on 31.3.1985, 13.78 lac watches have been assembled. HMT has set up 14 such units and the performance of this unit is very much encouraging and ranks at Number 2 in the country. In the year 1982, this Company has assembled 50,000 Appu' watches specially for the 9th Asiad. This project has generated employment to 110 persons of which 100 are ladies. This company is also running in profits and has also declared dividend during the year 1985 for the first time.

(D) Joint Sector Projects

1. Maharashtra Scooters Limited, Satara

WMDC and Bajaj Auto Ltd. in the year 1974 has set up a joint sector project namely Maharashtra Scooters Limited, which is manufacturing Priya' scooters. The Corporation has invested Rs.27 lacs towards equity share capital and has earned bonus shares to the tune of Rs.65.57 lacs. As on 31.3.1986, M.S.L. has manufactured 4.11 lac scooters. One of the special features to note is that during its first year of production, the Company has declared 12% dividend and during the year 1984-85, it has declared 25% dividend. As on 31.3.1986, the Corporation has earned Rs.43 lacs by way of dividend. This project has generated employment to about 800 persons.

2. Ajintha Pharmaceuticals Limited, Jalgaon

This Company has been promoted by Haffkine Bio-Pharmaceuticals Ltd., and WMDC to manufacture pharmaceutical items. The Corporation has invested Rs.4 lac by way of equity and during the year 1985-86 the Company has carried out sales to the tune of Rs.143 lacs through which, profits of Rs.2.55 lacs were earned.

3. Noduron Founders (Maharashtra) Limited

Dr. Ghate & Associates, SICOM and WMDC have set up this joint sector project in which WMDC's investment is Rs.32.50 lacs. The annual production

capacity of the company is to produce 72,000 tonnes of S.G. castings which is mainly ductile iron castings. The company has started its production during the year 1986.

(E) Projects Under Consideration

1. Sericulture Project

Taking into consideration the primary need and facility for silk industry in Maharashtra, the Corporation has decided to take up sericulture project on training cum production basis. Under this project, initially the Corporation plans to undertake Melberi plantation under Employment Guarantee Scheme. Under this scheme, persons would be trained for its maintenance and rearing of silk cocoons and further from silkyarn produced under scheme, it is proposed to produce silk cloth and sarees. The estimated expenditure of this project would be Rs.175 lacs of which, Corporation's share would be Rs.70 lacs.

2. Devdasi Project : Training-cum-Production and Rehabilitation Centre

In order to rehabilitate Devdasi, the Corporation has taken up a programme for upliftment of Devdasis by way of organising training class for production of knitwears. One such class was organised in Jath in Sangli district, in which trained devdasis are producing knitwears of very good and salable quality. WMDC has also come forward to undertake the responsibility for marketing the knitwears produced at Training-cum-Production Centres. WMDC had displayed their items in various exhibitions and had undertaken sale of their knitwears through participating in various exhibitions. The Training-cum-Production Centre at Sangli is going on very well. With the experience of Sangli Centre, WMDC has set up one more Training-cum-Production Centre at Gadhinglaj in Kolhapur district. This centre has been approved by Government of Maharashtra and Government has sanctioned an amount of Rs.25 lacs for implementation of the scheme for betterment of Devdasis. At the Gadhinglaj centre, about 50 devdasis are being trained. By setting up these Training-cum-Production Centres for devdasis, WMDC has got privilege of upliftment of down-trodden sections of our society.

वाढता वाढता वाढे....



महामंडळाची वैशिष्ट्ये

- ★ बीज भांडवल
योजनेत महाराष्ट्र
राज्यात अग्रेसर
- ★ पॅकेज स्कीम
खालील सवलती
वाटण्यात प्रथम
क्रमांक

बीज

पॅकेज स्कीम

- ★ लहान उद्योजकांना वाटण्यात आलेले
स्पेशल कॅपिटल इन्सेन्टीव्ह,
एम.आय.डी.सी. इन्सेन्टीव्ह व
विक्रीकर कर्ज : रु. १० कोटी ६१ लाख
- ★ पॅकेज स्कीमचा लाभ मिळवून दिलेले
लहान उद्योजक : २१३१
- ★ पॅकेज स्कीमने निर्माण केलेला रोजगार : ३५ हजार
व्यक्तींना

बीज भांडवल कर्ज योजना

- ★ स्वयंरोजगारासाठी मदत केलेले
सुशिक्षित बेरोजगार : २६ हजार
- ★ सुशिक्षित बेरोजगारांना वाटलेले
बीज भांडवल : रु. १७ कोटी ६० लाख
- ★ वरील सुशिक्षित बेरोजगारांना
स्वयंरोजगारासाठी वित्त संस्थांकडून
मिळालेले कर्ज : रु. १२० कोटी
- ★ बीज भांडवल योजनेने निर्माण केलेला : ५६ हजार
रोजगार व्यक्तींना

सौ. लीना मेहेंदळे व्यवस्थापकीय संचालक

उल्हास पवार अध्यक्ष



पश्चिम महाराष्ट्र विकास महामंडळ मर्यादित

"कुबेरा चेंबर्स", २ रा मजला, जंगली महाराज रोड, पुणे ४११ ००५.

INDIAN INSTITUTE OF SUGAR CANE RESEARCH

Lucknow 226 006

The Institute at Lucknow conducts researches in agronomy, plant physiology and biochemistry, agricultural engineering, agricultural chemistry and soil science, soil microbiology, plant pathology, nematology, entomology, botany and breeding, extensions and statistics and economics. Recently two laboratories, one on radio-isotopes and the other on residue analysis besides training and communication centre have been started at this Institute. Two ad-hoc research schemes had been sanctioned by the ICAR one of biological control of stalk borer, internode borer and top borer of sugarcane through indigenous and exotic parasites and the other on determination of physical and biotic factors responsible for pyrilla epidemics. In addition to these five more centres on biological control at Golagokarannath, Captainganj (U.P.), Dimapur (Nagaland), Rudrur (Andhra Pradesh) and Pravarannagar (M. S.) have been opened. For augmenting sugarcane production in the country, researches on sugarcane have further been intended by the ICAR during 1981 by sanctioning 9 research schemes financed from A. P. Cess Fund. Besides, two more PL 480 schemes on Photo-synthesis and crop productivity have been in operation since 1981. These schemes have been sanctioned for a period of 3 to 5 years under the administrative and technical control of I.I.S.R., Lucknow. An operational research programme of the Institute is in progress in the Balrampur Chini Mills Ltd., Balrampur zone in district Gonda of U.P. where the important research findings are tested before they are released for general adoption by the farming community. Lab to land Programme is also in operation in three villages, namely, Daniyalpur, Dharsaina and Hausmen in Banki block of district Barabanki (U.P.) under the technical guidance of Scientists of this Institute where the implementation of improved production, technology have shown yield improvement of 15-40%. The overall objective behind these researches is to produce more in lesser time and space besides giving longer lease of life to sugarcane varieties by exploiting the genetic potential in more favourable environments than in existence at present.

Researches on sugarbeet and sweet sorghum were initiated by the Institute. It has been established

that sugarbeet cultivation in the plains and its seed production in the hills are economically viable propositions in India. Experiments in sweet sorghum are on hand at the Institute and for the first time jaggery has been prepared with the juice of its stalk.

The Institute coordinates the researches on sugarcane on all India basis through the Project coordinator (Sugarcane).

The Institute conducts a 4 month duration training course for sugarcane development officers, extension officers on the scientific and practical aspects of sugarcane culture. In addition to this, short training courses are also arranged frequently by the Institute for imparting training to the factory and cane development staff in operating the hot air unit for three tier seed programme of sugarcane and in the improved cultural practices of sugarcane. Demonstration of the performance of new agricultural machinery designed and fabricated by this institute and also the new techniques of growing sugarcane and organising the farmers fair have formed a regular programme for dissemination of research results of practical value for the benefit of the masses.

The Institute caters information to various type of inquiries pertaining to technical and advisory nature by Central, State, Industry, private institutions and individuals from country and abroad.

The Institute is recognised by Agra, Kanpur, Lucknow (U.P.), Rahuri and Akola (Maharashtra) universities for guiding researches in the various disciplines of sugarcane culture for the award of Ph.D. degree. The Institute offers research facilities to research fellows, emeritus scientists and pool officers also in the culture of sugar crops.

An Association of Sugarcane Technologists of India has been formed recently with its headquarters at the Institute. It has at the moment 190 members from all over the country. The Association has been bringing out half yearly journal 'Indian Journal of Sugarcane Technologists'.

MANAGEMENT DEVELOPMENT INSTITUTE

Regd. Office:
Jeevan Tara, 5 Parliament Street,
NEW DELHI 110 001

The Management Development Institute (MDI), New Delhi, sponsored by the Industrial Finance Corporation of India (IFCI), is an autonomous body registered under the Societies Regulation Act, 1860 and was established in 1973.

MDI seeks particularly to fulfil the needs of industry in the field of management development and research in an effort to promote the application of management science generally to industrial concerns. MDI considers the quality of day-to-day management crucial for the success of an industrial venture. In order to effectively assist participants in tackling practical problems at the management level through various training and development programmes at the Institute, the core faculty of the Institute has been drawn from practitioners in different areas of management who combine an academic base with managerial experience in various branches of Industry in India. MDI endeavours to develop a certain fusion of academic and practical orientation in its programmes.

The Board of Governors of MDI consists of a Chairman and fourteen members which represent the Industrial Finance Corporation of India, the Industrial Development Bank of India, the Ministry of Finance, GOI, KFW, W.Germany, business, financial and management educational institutions.

The Board of MDI and IFCI established the Development Banking Centre (DBC) in November 1977 to meet the needs of training technical advice and research of the growing sector of financial and promotional institutions.

MDI Campus

MDI is now located in its own Campus near Gurgaon, Haryana. The Campus lies at the junction of Mehrauli-Gurgaon road and Jaipur bye-pass road. It is about 12 km from Connaught Place, New Delhi. The campus is laid out on 36 acres of land which consists of faculty and administrative blocks, lecture theatre and syndicate rooms and library. The participants

in the MDI programmes to be organised on the Campus will be accommodated in the Hostel which consists of 33 single rooms and 33 double rooms. Catering is arranged on the Campus in the Dining Hall attached to the Hostel. Regular transport services ply between Delhi and Gurgaon.

Training Programmes

MDI runs a large number of short training programmes each year to cater to the needs of management cadres of different industries and of different levels. The programmes are also conducted in different parts of the country so that entrepreneurs from all corners of the country may take advantage of these training programmes. Recently a 3-year part-time post-graduate Diploma Course in Business Administration has been organised.

Staff

To carry on these training activities the MDI maintains a teaching staff consisting of 25 faculty members specialising in different management disciplines. The teaching staff and the training programmes are backed by a research staff consisting of 14 senior faculty members who carry on intensive research work on a variety of management problems. These research programmes have led to the publication of more than 23 books so far on various aspects of management in Indian Industry. The MDI has a large administrative set up consisting of 121 persons to implement and support its policies and programmes.

Key Personnel

The MDI is headed by Dr. N.K. Sengupta, a renowned authority on banking and finance who is presently Chairman of MDI. There are two positions of deanship in the MDI occupied by Shri M.L. Bery and Shri M.N. Khushu. Of these, Shri M.L. Bery, looks after management development Institute and Shri Khushu looks after the Development Banking Centre. Shri J.N. Kulkarni, a Senior Administrative Expert is functioning as Registrar-cum-Secretary of MDI.

NATIONAL CHEMICAL LABORATORY

Pune 411 008

Objective

The National Chemical Laboratory (NCL) was the first amongst the chain of laboratories established by the Council of Scientific and Industrial Research in 1950 with the objective of pursuing research in the chemical sciences for the benefit of the common man. The projects undertaken by the laboratory are concerned mainly with the national problems of food, energy, health and innovative utilisation of the available natural resources of the country. Besides these projects of long-term national concern, the NCL also undertakes short-term projects for meeting the immediate needs of the chemical industry. The NCL's aim is to combine excellence in chemical research with purposeful industrial involvement. The atmosphere of the laboratory reflects a unique synthesis of the free research culture of the university and the result oriented objectives of a national research centre.

Research Policy and Changes Therein

Established three decades ago on a breezy plateau in the western outskirts of Poona (altitude 560 metres, prominent educational centre, population 12 million, moderate climate), the first fifteen years of the NCL were spent in building up a high order of scientific research capability in chemistry and chemical engineering. Thereafter the laboratory turned its attention to industrial processes with the principal objective of import substitution through development of indigenous technology. During this phase the NCL established fruitful and effective links with the Indian chemical industry and developed a number of technologies which are being commercially exploited today; the total annual turnover based on 71 processes in operation in 1978 was about Rs.20 crores.

In order to fully exploit the growing interdisciplinary strength of the NCL (over 100 Ph.Ds. and M.Sc.s. helped by the most modern aids to chemical research available in India in terms of instruments, library and computational facilities) and its increasing industrial contacts, a research policy is needed that plans for the future and which at the same time is anchored to the present. Thus one of NCL's main thrusts will be on long-term projects as well as inter-laboratory projects involving more than one CSIR laboratory (All India Coordinated Projects). Some of the projects of the NCL's current research programme

reflecting this thrust are; rapid multiplication of plants by tissue culture, innovative processes for established drugs, conversion of cellulose to energy and protein, materials for solar energy collection, pest control agents through synthesis and isolation from plant sources, novel chemical transformations through catalysts, and projects in the field of polymer science and engineering.

One of the healthy developments of the present decade has been the increasing emphasis laid by industry on establishing its own R&D capability. While this helpful takes away from the NCL the major burden of developing technologies for immediate exploitation, there is still need for result oriented laboratories like the NCL to undertake short-term projects with well defined industrial involvement. Success of these projects will depend largely on the closeness and strength of the links established with the industry. The NCL has been successful in forging such links, and as a result has undertaken a number of projects in close collaboration with industry.

Facilities and Research Aids

The NCL has excellent pilot plant facilities. These include a fine high pressure laboratory with autoclaves for operation upto 350°C and 300 atmospheres with a gas compressor and circulation facility. A large variety of chemical reactors, distillation assemblies, evaporators, pumps, etc. are available at any time put together as a pilot plant assembly for various critical steps of a specific process. This provides for flexibility which is an asset in a laboratory like the NCL where pilot plants have often to be set up at short notice and dismantled with equal despatch.

The NCL Library, which is one of the best of its kind in the country, has an impressive collection of over 48,000 books, 30,000 periodicals, 8,500 reports, 4,000 Indian and British standards, 6,000 foreign patents and 280 theses (based on work carried out at the NCL). In addition, over 600 periodicals are being received. The library is an Inspection Centre for Indian patents and holds about 75,000 printed patents. The average annual addition of these patents is around 5,000.

The NCL also has a fine glass blowing section, perhaps one of the finest in a developing country. This section is able to fabricate intricate glass apparatus for laboratory research, even small all-glass pilot plants.

The laboratory also has well equipped workshop facilities (mainly mechanical and electrical) which are used effectively for fabricating and installing special equipment and pilot plants, besides maintenance of existing equipment.

The instrumentation section helps not only in the maintenance of sophisticated instruments but has also developed some specific instruments like vapour phase chromatograph, polarograph, IR/UV spectrometer, etc. through its own R&D efforts.

Excellent analytical and computational facilities (ICL 1904S, third generation computer) are available to ensure that the laboratory's programme is fully supplemented with modern aids.

Sophisticated Instruments

With recent advances in instrumentation and development of some of the most powerful and sophisticated analytical tools, researches can probe into their problems to a depth and accuracy hitherto not possible. To keep pace with international research in chemistry and chemical technology, which is becoming increasingly dependent on sophisticated instruments, the NCL has been investing heavily in modern instruments. As a result of this policy the laboratory is today probably the best equipped chemical research laboratory in the country.

In addition to the standard equipment like gas chromatographs of all types including a high pressure liquid chromatograph (Water Associates, USA)

spectrophotometers (of all colours and hues), proton resonance spectrometers, mass spectrometers, X-ray diffractometers and a host of other conventional analytical and metering instruments, the NCL has some very sophisticated instruments such as X-ray photoelectron spectrometer (ESCA-3 Mark II-Vacuum Generator, UK), Fourier-transform NMR (WH 90-Brucker, Germany), scanning electron microscope (Cambridge Stereoscan 150-Cambridge Scientific Instruments, UK), X-ray fluorescence spectrometer (Meca ION 44-Link System, UK), X-ray powder diffractometer (PW-1730 Phillips, Holland), Ge-mass spectrometer (MS 30-AEL UK), atomic absorption spectrometer (SP 1900-Pye Unichem, UK), Mossbauer spectrometer thermal analyser Netzch STA 309, West Germany).

The development of the polymer industry in the world is due to the large scale research and development efforts on polymers. NCL has a strong group in polymer chemistry. It is now proposed to launch an ambitious programme of research in polymer science and engineering with emphasis on polymer physics, polymer rheology, polymer reaction engineering and polymer processing. As a first step in this effort, adequate investment has been made for creating facilities in physico-chemical and mechanical analysis of polymers. A wide range of equipment have been procured such as differential scanning colorimeter, thermo-mechanical analyser, thermogravimetric analyser gel permeation chromatograph, vapour pressure osmometer, high speed membrane osmometer, light scattering photometer, Weissenberg rheogoniometer, Brabender plasticorder, instron rheometer, Ferranti-Shirley cone and plate viscometer, and rheovibron viscoelastometer.

**WE UNDERTAKE
TURN KEY CONSULTANCY ASSIGNMENTS
FOR
DISTILLERY, ALCOHOL BASED BY-PRODUCTS,
EFFLUENT TREATMENT, EXPANSION SCHEMES,
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PARTICLE BOARD PLANTS**



TRINETRA ASSOCIATES

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PUNE - 411 030
Tel. : 447101

DIRECTORATE OF SUGAR GUJARAT STATE

AHMEDABAD 380 001

Sugar Industry occupies an important place in the sector of Agricultural Produce Processing units. Organisation of such Cooperative Processing Societies for Agricultural Produce was already well known in Gujarat which has earned name and fame by organising Cotton Processing and Marketing on cooperative basis. In the case of Gujarat, a distinctive feature of the development of sugar industry is that all the sugar factories are in the cooperative sector. Another important feature is that the Cooperative Sugar Factories are also Cooperative Societies, of producers of sugarcane. The then Bombay State undertook a programme of organising sugar factories through cooperative of sugarcane growers. As a part of this programme, three cooperative sugar factories of Kodinar, Bardoli and Gandhinagar were organised. These three cooperative sugar factories were already in operation when the Gujarat State came into being in 1960. Because of the importance laid on Agro-Industries and the decision of the Government of Gujarat to give all possible encouragement and help to such agro-industries units of processing of agricultural produce and particularly crop. Sugar factories have come up in good number. Thereafter all the new sugar factories have been organised in the cooperative sector only. In fact, it has always been the policy of the Government of Gujarat, to encourage establishment of sugar factories only in cooperative sector. Thus starting with a humble beginning of 3 cooperative sugar factories, prior to 1960, the sugar industry in Gujarat has recorded rapid progress. Today there are 16 registered cooperative sugar factories in Gujarat of which, 16 are in operation. A State level Federation of Cooperative Sugar Factories, viz., Gujarat Rajya Sahakari Khand Udyog Sangh has also been set up. The State level advisory committee has been appointed which advises the sugar factories on placing of orders for plant and machinery and on appointment and for plant and machinery and on appointment of key personnel.

All matters relating to Cooperative Sugar factories are being dealt with in department of cooperation. Only in case of licensing factories and expansion

of the sugar factories, the Industries Department of the State comes into picture. Matters relating to distribution of Molasses are dealt with both in the Industries Department and in the Prohibition and Excise Department. It has been in consideration since long that there should be a single focal-point in which the problems of this Industry could be dealt with. In Gujarat the supply of sugarcane to Cooperative sugar factories does not pose any problem since the cane growers are usually members of the factories and there is no competition from the private sector. However, certain other problems arise, of which, the main one is the demand of the Gujarat State Federation of Cooperative Sugar Factories that all the matters relating to Cooperative Sugar Factories must be dealt with at one point so that, it becomes easy for the Federation to get guidance and to pursue matters without having to contact numerous authorities. Against this background, the objective of setting up of a separate Directorate of Sugar could be to bring under one organisation all the states' functions relating to the Sugar Industry. In view of this state government has decided to set up a new organisation for the Sugar Industry and issued orders to set up the Directorate of Sugar in the Cooperation Department at the head quarters now at Gandhinagar with supporting staff and also regional offices at Surat and Rajkot. The post of Director has been filled.

The main functions of the Directorate of Sugar shall be as under :

1. Formation of sugar factories, matters relating to plant erection, finance and management of these sugar factories and modernisation of sugar plants.
2. Matters relating to establishment of industries ancillary to sugar industry.
3. All matters relating to the Khandsari Units.
4. All matters pertaining to sugar industries and Khandsari units not specifically assigned to any other Department.
5. to follow up and to take remedial action on the audit reports referred to by the auditors of Cooperative Sugar Factories.

DIRECTORATE OF SUGAR-MAHARASHTRA STATE

Pune 411 042

Before 1971, the administration of the Cooperative Sugar Factories in Maharashtra was being looked after by a small cell of about 5 staff members including gazetted officers, working as a part of the office of the Commissioner for Cooperation and Registrar, Cooperative Societies, Maharashtra State, Pune. As the number of cooperative sugar factories were rising every year, a need was felt to strengthen the organization. Hence a separate office with nomenclature "Directorate of Sugar, Maharashtra State, Pune" was created with effect from 1st November 1971, headed by the Director of Sugar and Additional Registrar, Cooperative Societies, to deal with the administration of cooperative sugar factories in Maharashtra State. The Directorate deals with all aspects of Sugar Industry and generally coordinates all policies and execute matters relating to sugar and by-product industry.

Administrative Set Up

(A) Head Office

At present Shri S.D. Patil, I.A.S., is holding the post of the Director of Sugar, with effect from 6.6.1985, assisted by two Jt. Directors (Cooperation), two Dy. Directors (Cooperation) and four Asstt. Directors of Cooperative Department in the Head Office. The Head Office is also additionally equipped with one more post of Jt. Director from Agriculture Department, a Statistical Cell headed by the Statistician (Dy. Director of Economics & Statistics), Accounts Branch consisting of Dy. Director of Accounts Treasury as Accounts Officer assisted by Asstt. Accounts Officer and a technical cell consisting of an Executive Engineer and a Dy. Engineer from P.W.D. The Head Office also employs the staff of 59 non-gazetted officers of which 46 are Class III employees and 13 are peons. The non-gazetted staff is from Cooperative Department itself. The Head Office of the Directorate is at Pune.

(B) Regional Offices

There are 6 regional offices of the Directorate equipped with the staff from Commissionerate of Cooperative only. Each regional office is headed by Regional Dy. Director (Sugar), Asstt. Director, four Class III employees, two peons and one driver. The six R. D. Ds. are situated one each at Pune, Ahmednagar, Kolhapur, Aurangabad, Nanded and

Nagpur.

At present there are 100 registered cooperative sugar factories of which 91 are licenced and of them 79 are actually in operation in Maharashtra State in January 1987. Of the other 21 sugar factories, 9 are under erection, 9 are defunct societies and 3 factories have not taken up the crushing operations during 1986-87 season. In addition to this, 11 private (Jt. Stock) sugar factories are there in the State of which one has transferred its licence to the cooperative sugar factory, 3 have not taken up their crushing operations during 1986-87 and remaining 7 are in operation. The sugar factories in Maharashtra crushed 179.04 lakh tonnes of sugar cane during 1983-84, 208.44 lakh tonnes of sugarcane during 1984-85 and 213.21 lakhs tonnes of sugarcane during 1985-86. They produced 19.13 lakh tonnes, 23.11 lakh tonnes and 23.88 lakh tonnes sugar during the respective years during 1983-84 to 1985-86. The average recovery is 11.13%, 11.08% and 11.20% respectively. The % utilisation of installed capacity was 82.8, 88.8 and 89.8% during the respective years. During the current sugar year, it is expected that the sugar factories will crush about 203 lakh tonnage of sugarcane producing about 22.33 lakh tonnes of sugar with the average recovery of about 11%.

The Director of Sugar runs the Directorate of Sugar independently under the administrative control of the Cooperation Department of Government of Maharashtra. The functions of the Directorate of Sugar relating to the Sugar Industry have been listed below :

(i) Organisation, registration and supervision of Cooperative Sugar factories which would include preparation and scrutiny of project reports, selection of sites for the sugar factories, matters relating to appointment of Managing Directors, arrangements regarding long term loans and working capital finance, compliance of special audit report and supervision etc. For these purposes, the Director of Sugar is conferred with all the powers of the Additional Registrar of Cooperative Societies.

(ii) Introduction of uniform system of accounting in all Cooperative Sugar factories, inspection of accounts, statements and advice regarding improve-

ments in accounts, steps necessary to reduce the cost of production of sugar.

(iii) To assess the working efficiency of Cooperative Sugar factories covering the engineering and technical aspects of these factories examining the technical feasibility or otherwise of expansion proposals of Cooperative Sugar factories and to recommend the same; to review the progress of the execution of erection work and expansion programme and to advise Government regarding speedy implementation of the erection/expansion programme; to assist the factories in the preparation of tender specifications for machineries and various other works.

(iv) Promotion and coordination works relating to the by-products industries like distilleries, paper plants and other allied chemical industries etc.

(v) Fixation of advance payments for sugarcane price and fixation of final sugarcane price.

(vi) All questions relating to purchase tax on sugarcane and its utilisation.

(vii) Matters relating to the development and regulation of Khandsari Industry, excepting the gur making industry.

(viii) Demarcation (Zoning) of cane supply areas of factories.

(ix) To scrutinise and forward applications through the State Government for loans from the Sugar Development Fund of 1983 to the Central Government made for the sugar factories and to help them to obtain the loan.

Monitoring of the cane development activities in the factory areas with the help of the abovementioned loans and also with the finances available from the sugar factories. These funds going to utilise for increasing the raw material availability to see that factories or undertakings will not suffer for want of raw material.

The matters relating to export quotas of sugar and by-products, pricing policy of sugar and its by-product, releasing sugar quotas from the sugar factories depending upon the burden of stocks etc. is within the jurisdiction of Central Government and is administered by the Director of Sugar, Government of India, New Delhi. The distribution of released quotas of sugar for State is administered by the Civil Supplies Department of the Maharashtra State and control over the distribution and utilisation of the molasses, by-products of sugar industry, is administered by the Excise Department of the State.

SUGAR INDUSTRY IN MAHARASHTRA STATE At A Glance

Area under Sugarcane : 3.54 lakh hectares
(1984-85)

Average yield per hectare (1984-85)	: 79.50 MT
No. of working sugar mills (1985-86)	: 92
Out of which Cooperatives	: 82
Per day crushing capacity	: 1.62 lakh MT sugarcane
Average duration of season (1985-86)	: 142 days
Sugar production (1985-86)	: 23.88 lakh MT
Average sugar % cane	: 11.2%
Percentage to National Production	: 34%
No. of sugar factories under erection	: 9
No. of Distilleries operating	: 30
Out of which cooperatives	: 20
Cooperative Distilleries under erection	: 24
Cooperative Paper Plants working	: 4
Cooperative Paper Plants under erection	: 6
Cooperative Chemical Plants working	: 5

Other Institutions :

1. Deccan Sugar Institute
2. National Heavy Engineering Co-op. Ltd.

Programme Till 1990-91

No. of factories	: 145
Per day crushing capacity	: 3.9 lakh MT
Total sugar production	5.25 million tonnes
Capital Investment	: Rs.11700 millions

The State is known as the 'SUGAR BOWL' of India. It is located in the tropical belt between 16.4° North and 22.1° North. This belt comprises of areas such as Hawaii, Taiwan, West Indies, Cuba, Mexico, Brazil, Mauritius and Queensland and is famous for cultivation of sugarcane crop. The sugarcane yields

in Maharashtra are high at about 120 MT per hectare and sugarcane percent is also high at about 11.08%.

In Maharashtra State, at present 92 sugar factories are working with installed crushing capacity of more than 1.60 lakh MT of cane per day. Out of these, 10 are from Joint Stock Sector and 82 are from Cooperative Sector. Besides these factories, 3 new cooperative sugar factories will go on the stream of production during 1986-87. State Government has recently placed orders for machinery for 9 new cooperative sugar factories. Applications of about 45 cooperative sugar factories are under consideration of Government at various levels.

During 1985-86 season, 92 sugar factories were working in the State of Maharashtra out of these 82 are from cooperative and 10 from Joint Stock. These factories produced 23.88 lakh MT of sugar and this represented 34% of the national production of 69.75 lakh MT (approx.) in 1985-86. State of Maharashtra has been occupying leading position among the States in the country since last few years. During the crushing campaign, the production in the State is likely to exceed that of the previous year by sizeable amount. The climatic conditions in the State of Maharashtra are favourable for cultivation of sugarcane. However, soil available is not very fertile and water poses certain problems. The present sugarcane areas were previously permanently draught prone areas and the then Government of Bombay introduced the Deccan Irrigation Canals mainly as famine relief works.

The Tariff protection given by Government of India to the sugar industry in the early 1930's acted as a great catalyst for the first phase of the growth of sugar industry in the State. About 10 joint stock factories came to be established in the State during the 1930's. About the same time, Central Sugarcane Research Station was established in the State at Padegaon (Dist. Pune).

The private sugar factories established their own captive sugarcane farms and these factories were responsible for the transformation of arid famine stricken areas in the State into fertile, prosperous and revenue yielding sugarcane farms. Modern agricultural techniques were put into practice to increase yields after necessary research work. Improved cane varieties were planted and cane yield was raised and cane quality was improved. The beneficial factors of the sugarcane farms created in the regions of a number of agriculturists with an insight into the techniques of modern agriculture. The establishment of private sugar factories and their growth till 1950 marked the first important phase of the growth of

sugar industry in the State.

The period thereafter observed the significant growth of the cooperative sector of the sugar industry. The first cooperative sugar mill was established in Ahmednagar District, in early 1950's. The success of this sugar factory brought the realisation both in the Government circles and in the cooperative movement that the best form of business organisation for an agricultural processing industry was a cooperative of the primary agricultural producers. With the active assistance of the State and Central Governments, the sugar industry in the cooperative sector has registered phenomenal progress. With the growth in the number of cooperative sugar factories and with the opening of additional irrigation facilities, the area under cane recorded an extremely impressive growth. In the year 1950-51, the area under sugarcane was 1.88 lakh acres for the then Bombay State including Gujarat and parts of Mysore. Within two decades the area under sugarcane in Maharashtra itself went upto by 8.85 lakh acres (3.54 lakh hectares), a rise of nearly 470%. However, it has to be remembered that inspite of this rapid increase in acreage, the sugarcane acreage in the State forms about 1.5% of the total crop area in the State. This indicates at once the impressive growth of the industry during the last 3 decades as well as the vast potential for the future growth.

Future Growth

The State has placed before itself a target of 145 sugar factories working by 1990-91 i.e. by end of the Seventh Five Year Plan. With the establishment of these sugar factories, the sugar production in the State of Maharashtra is expected to reach 5.25 million tons. The total investment is expected to be as follows :

	Rs.in Millions
(i) Setting up of new factories	5,400.00
(ii) Expansion of existing factories	1,800.00
(iii) By-product industry	4,500.00

The sugar industry in Maharashtra stands in class by itself and among the most efficiently run industries in the whole of India. The sugarcane yields are high, the sucrose percentage of cane is high. The duration of the season is longer and the machinery is most modern. The quality of sugar is good and the contribution of the sugar industry in Maharashtra to the sugar exports of the country is very significant. The cooperative sector of sugar industry in Maharashtra leads the cooperative sugar sector in the entire country. The cooperative sugar factories in Maharashtra produced about 66 to 70 percent of the production of the cooperative sector of the country. These factories are owned

by small individual growers.

The small individual farmers constitute 49.60% of the total membership cultivating just one acre of sugarcane per member, and members cultivating between one to two acres constitute about 27.38% of the total membership. Thus members of the cooperative sugar factories are overwhelming small farmers and they own and democratically operate their own sugar cooperative. About one-third of the employees of the cooperative sugar factories come from the socially backward strata of the Society. The sugar cooperatives have changed the entire shape of the surrounding areas through :

- (i) Economic uplift of dry farmers;
- (ii) Development of education facilities;
- (iii) Medical and health facilities;
- (iv) The cooperative sugar factories' management have adopted a liberal labour policy towards labour and workers and they have been given due representation in the management.
- (v) Compulsory deductions from the cane price towards common causes.

**Contribution for Social Causes by
Cooperative Sugar Factories
in Maharashtra State**

(Rs.in lakhs)

Particulars	Total upto 1984-85 season
Area Development Fund	2587.39
Deccan Sugar Institute	985.68
Cooperative Press	37.00
Small Saving	1509.65
Hutments for Landless	713.16
Chief Minister's Fund	930.60
Sugarcane Development Fund	805.85
Education Fund	239.34
TOTAL	7808.67

Sugar Production

(Figures in million tonnes)

Year	Mahara- shtra	Rest of India	Total	Production of Maharashtra State as % of Total
1966-67	0.63	1.51	2.15	29.66
1971-72	1.00	2.11	3.11	32.19
1976-77	1.56	3.28	4.84	32.50
1980-81	2.09	3.06	5.15	40.60
1981-82	3.03	5.52	8.60	35.30
1982-83	3.02	5.24	8.26	36.56
1983-84	1.99	3.91	5.90	33.72
1984-85	2.31	3.66	5.97	38.69
1985-86	2.39	4.59*	6.98*	34.24

* approx.

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Chairman

THE KRUSHIUDYOG MAHAMANDAL

(The Maharashtra Agro - Industries Development
Corporation Ltd.)

The 'Krushiudyog Mahamandal' was set up on 15th December, 1965 by the Government of Maharashtra under the Companies Act to encourage farm mechanisation throughout the country and to distribute and manufacture agricultural inputs. The Central and the State Government have contributed towards its equity share capital. The authorised capital is Rs.8.00 crores.

It was established to promote introduction of farm mechanisation and to undertake distribution of agricultural machineries; to promote and execute promotion preservation and supply of food and to provide technical guidance to farmers and persons concerned with Agro Industries and to enable efficient conduct of the enterprise.

Based on the above guidelines it has the following activities :

1. To manufacture and distribute agricultural farm machinery
2. To formulate pesticides and insecticides
3. Manufacture and distribute chemical fertilizers and organic manures
4. Processing of fruits and vegetables
5. Manufacture and distribute animal feeds for dairy, poultry etc.
6. Export agricultural produce and allied products.

It also has set up R&D facilities to improve existing farm implements and design new ones.

The Maharashtra Agro-Industries Development Corporation Limited (Krushiudyog Mahamandal) has expanded and grown over the years and deals in several makes of indigenously manufactured tractors, power tillers, trailers and a whole range of agricultural implements, tractor drawn, bullock drawn and hand tools.

At present it is the authorised dealer for (1) HMT Zetor, (2) Hindustan Tractor, (3) Kubota Power Tillers and (4) Mitsubishi Power Tillers. Besides this, the Corporation manufactures various improved agricultural implements and plant protection equipments in its Agricultural Engineering Workshop at Chinchwad, Pune.

The Corporation also provides after-sales service and provides spare parts to needy farmers at reasonable rates.

Fertilizers are manufactured and sold under the brand name 'Krushiudyog'. The Corporation has established three manufacturing units which are based at Rasayani (Raigad), Pachora (Jalgaon) and Nanded with an annual production of 45,000 MTs for each unit.

The organic fertilizers unit is set up at Pune. The Corporation has set up a Compost Plant, through Maharashtra Organic Manures Ltd., a joint venture with Pune Municipal Corporation. The Corporation has undertaken the manufacture and marketing of Rhizobium Culture at its plant at Goregaon, Bombay.

The pesticides formulation plant at Akola is in operation since March 1984, through a separate company called M/s Maharashtra Insecticides Private Limited.

'SUGRAS' is the brand name for animal feeds which was started in 1969-70. The Corporation manufactures cattle feeds, poultry feeds and other specialised animal feeds under strict quality control at various manufacturing units.

The following types of feeds in mash and pellet forms are manufactured :

Cattle Feeds like super milk ration for buffaloes/cattles.

Special Milk Ration/High Performance Milk Ration - for growing and high yielding cattle.

Milk Ration for pregnant and milking cows and buffaloes.

Dairy-Stock Ration for dairy cow and draught cattle who need strength for work.

Calf Ration for calves and young animals.

Other Varieties - Common ration and economy ration.

Poultry Feeds - Chick mash, grower mash, layer mash.

Others : Pig feed, Horse feed, Sheep feed.

In 1972 the Corporation took over the Noga Food Processing Factory at Nagpur. Various types of squashes, jams, ketch-up sauce, canned fruits and vegetables are produced. The canned and bottled products of Noga are exported to various countries, like Middle-East etc. Iron and Steel sheets are distributed to agriculturists for agriculture purposes.

The Corporation has a separate Export and Import Division. Besides exporting Noga products it also exports vegetables, fruits and oil seeds extractions.

COLLEGE OF AGRICULTURAL BANKING(CAB)

164 B, Ganeshkhind Road,
PUNE 411 016

The College of Agricultural Banking, a training establishment of the Reserve Bank of India, was established on 29th September, 1969. It was then known as Cooperative Bankers Training College (CBTC) and the courses were conducted for officers of cooperative banks. Subsequently, commensurate with the entry of commercial banks in the field of rural credit and cooperative banks diversifying their functions to cover non-conventional areas, there was a significant change in the activities of the College which also came to be symbolically renamed as 'College of Agricultural Banking (CAB) effective from 6th February, 1974.

CAB is the apex institution for rural orientation and training in agricultural banking. It trains senior and middle-level officers of commercial cooperative and regional rural banks as also officers of State Governments, Government of India, Reserve Bank of India and NABARD connected with retailing credit both for investment and working capital purposes in agriculture, allied activities and non-farm sector. CAB conducts a wide variety of about 25 programmes covering basic, specialised and functional courses in diversified areas in agricultural financing, rural development and allied activities. Some of the important regular programmes are Agricultural Projects Course (APC - 4 weeks), Programme on Financing of Integrated Rural Development (IRDP - 3 weeks), Rural Financing Programme for Officers (RRBs - 4 weeks), Development Programme for Officers of State/Central Cooperative Banks (SCB - 3 weeks) and other programmes are in specific discipline such as Financing, Plantation, Horticulture, Forestry, Gobar Gas Plants etc. The main focus of CAB's training activity is on developmental banking with reference to rural sector and the training strategy adopted aims at providing and updating

knowledge and skills in project planning and appraisal, project monitoring and follow-up in general and specific areas.

CAB also conducts outstation programmes to the extent possible and offers a few programmes for the faculty members of Banks' Training Institutions. Of late, a growing number of Afro-Asian countries are availing themselves of CAB's expertise by deputing their officers for training in CAB or by requesting CAB to design and conduct location specific programmes in their respective countries. Recently, the College conducted programmes on behalf of international organisations like FAO, Rome, Commonwealth Secretariat, London and APRACA, Bangkok. The Centre for International Cooperative and Training in Agricultural Banking (CICTAB) has assigned to CAB the task of conducting two programmes on 'Project and Production Finance for Rural Poor' on its behalf.

CAB has spacious campus endowed with learning environment. It has also got a good library, elegant audio-visual hall for screening films, auditorium and air-conditioned hall for seminar/conference etc. All courses are residential and meant for inservice personnel. Charges are recoverable, at prescribed scale, from sponsoring institutions.

In planning and organising its activities CAB is guided by an Advisory Committee presided over by the Deputy Governor of the Reserve Bank of India and represented by senior executives of commercial banks, RBI, NABARD, Government of India, etc. The College is headed by Principal, who is a very senior officer of the Reserve Bank. Presently, Shri R.A. Sugavanam is adorning the presiding chair of the College.

MAHARASHTRA SMALL SCALE INDUSTRIES DEVELOPMENT CORPORATION LIMITED

(A Government of Maharashtra Undertaking)

Maharashtra Small Scale Industries Development Corporation Limited was established in 1962 and this is the first Government Undertaking Corporation of its kind established for extending various types of assistance for the growth of Small Scale Industries all over Maharashtra.

During the initial stage, MSSIDC was distributing scarce raw material to the SSI Units; also, machinery was supplied on Hire Purchase basis. Since this was a very limited field, Corporation has introduced various other schemes such as :

- ° Marketing ° Handicrafts Development
- ° Commercial Warehousing ° Export Marketing

Raw Material Assistance

Scarce raw materials like Iron & Steel, Pig Iron, Coke and Coal, Paper, Alcohol etc. are being procured from main producers like Steel Authority of India, Tata Steel, Indian Iron & Steel, etc. The material procured is being distributed on the basis of assessment made by the Industries Department and recommendations given in respect of individual units. Wherever scarce material is received in small quantity the same is distributed on pro-rata basis for enabling maximum number of units to get the material for their intended production.

Handicraft Development

For providing marketing assistance for the various articles prepared by the small artisans such as wooden articles, leather goods, wall hangings, brass and other metal articles, Corporation has opened Emporiums at New Delhi, Sahar Air Port, World Trade Centre, Bombay and Nagpur, where the above articles are displayed and sold. Corporation also participates in various Exhibitions all over India where the products are exhibited and sold. For permanent exhibitions of the above articles, space has been reserved in World Trade Centre, Cuffe Parade, Bombay.

Commercial Warehousing

Various trading organisations as well as small scale units require space for storage of their products

either imported or to be exported. Bombay, being the port point, MSSIDC has introduced Commercial Warehousing facility at a very moderate rate for the benefit of all concerned.

Similarly, for the benefit of small scale units, Commercial Warehousing Department also deals with Imported Cement procurement and distribution, raw material required for the production of Polythene Bags etc.

Import Assistance

Recently, a scheme has been introduced for Import Assistance for the items viz. Low Density Polythelene (LDPE), High Density Polythelene (HDPE), Poly-Vinyl Chloride (PVC), Poly Propylene (PP) etc., Only the SSI (Actual User) Units in Maharashtra State registered with Directorate of Industries are eligible to get the assistance under this scheme.

Exports

For export-worthy items, assistance is rendered by MSSIDC for Export. A separate department is functioning at World Trade Centre, CuffeParade, Bombay where all the details are available for the benefit of SSI Units.

Internal Marketing

Besides all the above activities, Marketing is the main activity of the Corporation. Small Scale Units manufacturing various items are not getting direct orders because of the lack of follow-up, communication facilities etc. Corporation is dealing with Government Sector for their various requirements. For the benefit of small scale units, MSSIDC is forming consortia of SSI Units for items like RCC Pipes, Polythene Bags, Steel & Wooden Furniture. This facilitates a maximum number of units to share marketing orders.

The brief procedure for marketing is that a unit having SSI registration can register its name with MSSIDC for marketing of the products manufactured by this unit. All the Government/Semi-Government Departments and other local bodies are forwarding their requirements to MSSIDC and MSSIDC is quoting

the rates to concerned departments on behalf of SSI units. MSSIDC also participates in the enquiries of DGS&D, CSPO on behalf of its registered units; and rate contracts are finalised for specific periods. The order when received by MSSIDC is distributed amongst its registered units depending upon capacity assessment, distance factor etc.

Earlier, units were getting their payments after receipt of payment from the consignees. MSSIDC has, however, introduced certain new schemes for the benefit of small scale units marketing their products through MSSIDC. Details are as below :

(a) Advance against supply orders

Marketing units can be given advance to the extent of 75% of the order against the Bank Guarantee for matching amount at the interest rates finalised for the purpose. Interest rates are ranging from 14% to 17.5% and some times above.

(b) 90% payment against the delivery

90% payment is released against the receipt of inspection-cum-delivery challan in the prescribed format to all the units executing marketing orders

and 10% of the amount in balance will be released to the units after receipt of full payments from the consignees.

(c) Raw Material assistance to Marketing Units

The small scale units executing marketing orders through MSSIDC can be considered for raw material assistance on priority basis subject to overall availability.

For marketing assistance rendered to the small scale units by MSSIDC as above, service charges ranging between 3.5% and 4.5% are charged which is applied separately for developed and developing regions.

MSSIDC is celebrating its 25th Anniversary during this year.

Popularisation of Solar Cookers

MSSIDC has been selected for popularisation of Solar Cookers with the actual users. Central Government and State Government are giving subsidy to this item whereby selling prices for a Solar Cooker is fixed at Rs.340/- and it is available for sale at all its Divisional/ Regional and District Offices as well as with the dealers appointed by MSSIDC.

CENTRAL ELECTROCHEMICAL RESEARCH INSTITUTE

KARAIKUDI 623 006

The Central Electrochemical Research Institute was established in 1953. This is a unique multi-disciplinary institution of its kind where all aspects of Electrochemistry with its interfaces with Chemistry and Chemical Engineering, Physics and Physical Engineering, Metallurgy and Material Sciences and Biology and Environmental Sciences are studied under one roof both for understanding the phenomena of all photonic, electronic and ionic processes and for translating this understanding into viable technological propositions. The Institute, over a period of 3 decades has acquired expertise and capability in the various areas of electrochemical science and technology. The main objective of the Institute is to develop processes for products imported hitherto, develop new process appropriate and relevant to the needs of the country and to make advances in electrochemical science in general. Greater emphasis is laid on industrial research and schemes sponsored by industries/government departments. If industries pose their problems, the scientists are deputed for making on-the-spot study for trouble shooting. Consul-

tancy services are offered to industries in helping them to overcome their problems. The scientists from the Institute always look forward to challenging problems faced by the industries.

The R&D activities have been organised into 9 major divisions and each division is carrying out activities towards the following well oriented missions identified :

1. Corrosion Abatement
2. Metal Finishing
3. Batteries and Fuel Cells
4. Electrochemicals
5. Electrometallurgy
6. Electrochemical Materials Science
7. Electroanalysis and Instrumentation

Presently 203 scientific personnel supported by 509 supporting staff are working in this Institute.

The Institute has extension centres at Madras, Mandapam Camp and Cochin. Another Marine Electrochemical Centre is shortly coming up at Tuticorin.

NATIONAL SUGAR INSTITUTE

KANPUR

Introduction

Name & Address of Ministry/Department

Ministry of Agriculture
Department of Food,
Krishi Bhawan
New Delhi.

Name & Address of the Organisation

National Sugar Institute
Kalianpur
Kanpur

(A subordinate office to the Department of Food)

Year of Establishment : 1936

Brief History of Origin, Growth & Development

The establishment of an institute of Sugar Technology and Research in India for proper development of the sugar industry in the country and to maintain its efficiency was first recommended in 1920 by the Indian Sugar Committee appointed by the Government of India. The need for a central sugar research institute was also emphasised by the Royal Commission on Agriculture in 1928 and the Tariff Board in 1930. The Government of India accordingly established the Imperial Institute of Sugar Technology at Kanpur in October, 1936 by taking over the Sugar Section of the Harcourt Butler Technological Institute, Kanpur. The Institute was placed under the administrative control of the Imperial Council of Agricultural Research, but continued to be housed in the building of the Harcourt Butler Technological Institute, Kanpur. With the formation of the Indian Central Sugarcane Committee in 1944, the administrative control of the Institute was then transferred to that committee. Consequent upon India attaining independence, the name of the Institute was changed to Indian Institute of Sugar Technology. With the formation of the Development Council for Sugar Industry under the provisions of the Industries (Development and Regulation) Act, 1951, the functions of the Indian Central Sugarcane Committee were abridged and the administrative control of the Institute was thereafter transferred to the Government of India, Ministry of food and Agriculture (Department of Food) with effect from January, 1, 1954. In April, 1957, the name 'National Sugar Institute'. It was also decided that the Institute should have a building of its own.

The present site of the Institute buildings and the farm attached to it comprise 524 acres and these are situated on the Grand Trunk Road close to Kalianpur

Railway Station (a suburb of Kanpur). The offices and laboratories of the Institute were shifted to the new premises in 1963.

The area of the farm attached to the Institute is about 375 acres. The purpose of the farm was mainly to grow sugarcane and supply the same to the Experimental Sugar Factory and Khandsari Prayogshala. The area when acquired was a forest area and full of brick-kiln ravines. The area was highly undulated and was never under cultivation. The farm area had, therefore, to be developed before bringing it under cultivation. Till the end of Fifth Five Year Plan i.e. March, 1978 about 300 acres of land has been developed of which 280 acres have brought under cultivation. Further development of land has been suspended as per recommendation of the Advisory Board of the Institute at its last meeting held on 29.9.1978. Full attention is now being concentrated for efficient cane cultivation in the already developed area.

Present Status

The Institute is under the administrative control of the Government of India in the Ministry of Agriculture and Irrigation (Department of Food). There is an Advisory Board for the Institute under the Chairmanship of the Joint Secretary (Sugar) which recommends to the Government of India the Plans and proposals of the Institute for its development so as to serve the industry most efficiently. The organisational set-up of the Institute is given at Annexure-I.

Functions

The main functions of the Institute are :

- (1) to undertake research on (a) problems pertaining to sugar technology, sugar and sugarcane chemistry and sugar engineering in general and those of sugar factories in particular and (b) utilisation of by-products of sugar industry;
- (2) to render technical advise and assistance to sugar factories with a view to improving their efficiency and assist other sections of the industry and the Central and State Government in matter relating to sugar and allied industries.
- (3) to provide technical education in all branches of sugar chemistry technology and engineering and in Industrial Fermentation and Alcohol Technology and to provide training in research;
- (4) to prepare and issue Indian Sugar Standards;
- (5) to collect, collate and issue technical statistics;

relating to sugar industry; and

(6) to survey sugar factory plant and process for drawing up detailed survey report including advice, suggestions, long and short term recommendations covering all aspects or any particular field of aspect of the factory working and equipments in order to achieve efficiency and economy at every stage of production.

Apart from the fact that each of the above functions serves individually the causes of the industry, a combination of these functions under one roof leads to useful instruction between them. Advisory work for instance, helps in getting at the urgent a problem facing the industry for research and makes teaching by inculcating original approach in the taught and helps advisory work by new findings. Teaching helps in developing a versatility which is of immense value both in advisory work and in research. Collection, compilation and dissemination of information not only gives ready data necessary for all the other functions but also helps in developing full prospective of the industry. In return, the last function gets the 'Watch and Ward' service from the other three functions which helps in critical evaluation of the data compiled.

It is this happy co-ordination of the above three main functions viz. teaching, research and advisory that has enhanced the efficiency of such of the functions and thereby the value of the services rendered by the Institute. With a view to carrying out the above functions efficiently the Institute maintains a number of separate divisions each headed by a senior officer.

The following are the various divisions :

- (1) Sugar Engineering Division.
- (2) Sugar Technology Division.
- (3) Sugar Chemistry (Organic) Division.
- (4) Physical Chemistry Division.
- (5) Bio-Chemistry Division.
- (6) Sugar Chemistry (Agriculture) Division.
- (7) Chemical Engineering Division.
- (8) Survey and Information Division.
- (9) Advisory Division.
- (10) Design and Development Division.
- (11) Extension Service Division.

Besides the above there is the Administrative Division which looks after the administration of the Institute in respect of accounts, establishment and other related matters.

Divisions (1) to (7) have research laboratories attached to them and their work involves besides research, teaching and giving technical advice. The

Advisory Division is responsible for giving immediate advice to sugar factories on their day to day problems encountered during the course of sugar manufacture both on the technological and engineering sides. The Survey and Information Division is the repository of and clearing house for all technical information received from or supplied to the industry and is responsible for every kind of a documentation of technical literature and information. It coordinates the activities of the various divisions at the Institute amongst themselves and those of the Institute with the industry. The Design and Development Division works towards improving the existing designs of sugar factory machinery, standardization of various dealings and evolving new designs.

Activities

(1) Teaching

The Institute imparts training in various courses, the details of which are given in Annexure II. These courses are conducted in such a manner that the students after completion of their respective courses, can assume positions of responsibility. Students come for training not only from all parts of India but also from abroad. The Institute has so far trained candidates from Burma, Sri Lanka, Kenya, Nepal, Uganda, Egypt, Sudan and Vietnam. The Institute thus caters not only to the needs of the sugar industry all over India but has also acquired international status in the matter of training technical personnel for the sugar industry.

The Institute has got well equipped laboratories, library and workshop and the highest emphasis is laid on the practical aspects of teaching.

The Khandsari Prayogshala attached to the Institute provides practical training to the students of Khandsari Supervisor's Course and Khandsari Karigar Course besides being used for conducting researches on new equipments and process for Khandsari Sugar manufacture. The Sharkara Prayogshala (Experimental Sugar Factory) of 100 tonnes of cane crushing capacity per day, installed recently, provides practical training to the students of Associateship Course of the Institute in Sugar Technology / Sugar Engineering on all practical aspects of cane sugar manufacture. Workshop training and training for one complete crushing season in an outside commercial sugar factory also forms a part of curriculum of Associateship Course in Sugar Technology.

The Institute has also a sugarcane farm of 300 acres attached to it for growing its own cane for the Sharkara and the Khandsari Prayogshala and for

carrying out research relating to sugarcane and evaluating the performance of various varieties for purpose of sugar manufacture.

Lectures by eminent Indian and foreign scientists and technologists are also arranged on subjects relating to sugar and other allied industries for the benefit of staff and students of the Institute and technical personnel of the industry.

(2) Research

The Institute carries out research on the day-to-day problems of the sugar and its allied industries. Whereas emphasis is laid on applied aspects problems of fundamental importance are also undertaken as technology, derives its sustenances from original contributions. The results of research are published in scientific and technical journals of India and foreign countries. The more promising results are passed through different stages of development culminating in taking out patents in cases where considered necessary.

The Institute has also a system of coordinated research which means that if the Institute has to try out any solutions of problems on factory scale it endeavours to carry out such research trials in collaboration with sugar factories. The Institute invites sugar factories in India, to participate in carrying out these coordinated research problems and the investigations are then carried out in the factories which agree to collaborate.

The number of scientific and technical persons engaged in research at the Institute is given below :

(a) Director	1
(b) Professor, Chief Technologists and Chief Engineers	14
(c) Assistant Professors, Senior Research/Technical Officers	28
(d) Lecturers, Junior Technical Officers	12
(e) Technical/Research Assistants	31
(f) Research Scholars	13

As a result of investigations carried out at the Institute, it has been possible to evolve technique of machinery operation and manufacture to suit the particular conditions of working prevailing Indian Sugar Factories which have appreciably improved the efficiency of the factories. Some of the important achievements of the Institute in the recent years are given below :

(a) White Sugar Without Sulphur

The most outstanding success achieved by the Institute has been the solution of the problem

of shortage of sulphur for the manufacture of white sugar. A new process viz., Defce Melt Crystallization Process has been evolved based upon the fact that recrystallization leads to elimination of impurities. The process was successfully adopted in a commercial sugar factory in Madras State during the whole season 1966-67, manufacturing over 10,000 tonnes of good quality direct consumption white sugar without using sulphur. This outstanding work has also been recognised by the Inventions Promotion Board of India by way of an award of a cash prize of Rs.500/- made to the Director of this Institute and inventor of the process Shri Suresh Chandra Gupta on the occasion of the 21st Independence Day (1967).

(b) Demineralisation of Cane Juice by the Ion-Exchange Process

The Institute has developed a process of clarification of cane juice with the help of ion-exchange resins, which when applied to clarified juice of sugar factories, increase the recovery of sugar by about 0.6 - 0.8 percent on cane and the final molasses produced is edible. Work in the direction of deacidification of clear juice and decolorisation of syrup by ion-exchange resins which can be regenerated by cheap common salt (NaCl) has also been carried out at the Institute and in the laboratories of a few commercial sugar factories. The results have been very encouraging and details of full scale adoption of these resins in a few commercial sugar factories have been worked out. Two factories in Maharashtra State have entered into agreement with this Institute for commercial exploitation of the process.

(c) Treatment of Sugar Factory Effluents

A scientific, efficient and simple to operate process has been evolved for the treatment of sugar factory effluents. A plant designed for this purpose has successfully been worked at a sugar factory and this has since been recommended by the Government for adoption by sugar factories.

(d) Utilisation of By-products

Extensive work has been done on proper utilisation of by-products of the sugar industry viz., bagasse, molasses and press-mud and some of the important items are given below :

(i) Production of Bio-gas and Bio-fertilizers

An important utilization of bagasse that has been worked out is its conversion into bio-gas and bio-manure. For this purpose the wastes of cane sugar factories such as sugarcane tops, sugarcane leaves, trash, bagasse, press-mud etc. are mixed in different proportions with other agricultural wastes according

to their availability and are enriched with small quantities of nitrogenous and phosphatic nutrients. The bio-manure, so obtained is a very useful organic manure, rich in nutrients like potassium, calcium, phosphorus, nitrogenous and humus and very well compare with the farm yard manure. It has been estimated that if total quantity of bagasse produced in a sugar factory is converted into bio-gas and bio-manure, the gas evolved will furnish 63-70 percent of the calorific value of the total steam requirements of a factory and at the same time a substantial quantity of bio-manure will be obtained which can be used in place of fertilizers which are already in short supply in the country. A pilot plant for the production of bio-manure and bio-gas was erected at this Institute under the collaboration of Hungarian experts and the N.I.D.C. in 1962. Since then the plant is continuously working and the bio-manure produced is being used in the farm and the gas is being employed in laboratories of the Institute.

(ii) Products from Molasses

Products such as fodder yeast, Oxalic acid, lactic acid, citric acid, butanol can be made from molasses based on work done at the Institute.

(iii) Extraction and Modification of Sugarcane Wax

Techniques of extraction of crude wax from the press-mud of sulphitation sugar factories and purifying it for preparing an emulsion for coating on fruits and at the same time modifying it for various other uses have been successfully evolved.

(iv) Utilization of Press-mud of Carbonation Sugar Factories

Recently valuable work has been done in this direction and this press-mud has been found suitable to produce self-fluxing sinters with iron ore fines. Work is also in progress to make some cleaning agents therefrom.

(e) Fuel and Steam Economy

It has been possible to suggest measures of steam and fuel economy to the industry which resulted in considerable savings of fuel by sugar factories.

(f) Damp-proof Godowns for the Storage of Sugar

A method has been developed for the construction of godowns for safe storage of sugar.

(g) Improvement in Gur & Khandsari Industries

A number of far reaching improvements have been effected in the process and machinery employed by the Gur and Khandsari industries e.g. the six roller crusher, the wet bagasse horse-shoe type furnace, sulphitation equipment, sugar drying hopper, improved bals etc. with very beneficial results.

(h) Processing Sugar Beets for Manufacturing Sugar under Indian Conditions

Pilot scale trials on sugar beet cultivation and its processing with an imported beet pilot plant conducted at Yamunanagar (Haryana), Bhogpur (Punjab), Sri Ganganagar (Rajasthan) and Daurala (U. P.) have established the feasibility of raising sugar beet crop on commercial scale in these States. After being convinced about the techno-economic feasibility, the management of Ganganagar Sugar Mills Ltd., Sriganganagar (Rajasthan) has placed an order for cane cum beet diffusion plant of 1300 tonnes cane or 650 tonnes beet handling capacity per day. The plant has since been commissioned.

The processing of sugar beet for the manufacture of sugar in cane sugar factories located in northern India will go a longway in improving their financial conditions, because sugar beet will supplement cane crushing operations and thereby overall duration of operation of factory will be increased and so the sugar recovery also on account of higher sugar content in sugar beet.

(i) A new chemical viz. INSTOL has been developed at this Institute as a substitute for improved chemicals like Hodeg and Cutol etc. which are used as a viscosity reducing additives in vacuum pans in a sugar factory. It was patented. The chemical has gained much popularity in the sugar industry. By the use of this chemical the boiling and curing time of the massecuite is reduced considerably apart from better exhaustion of molasses and uniform grain size on account of better circulations in pans and crystallisers. The Patent Right has now been transferred to the various firms in India for its commercial exploitation.

(ii) **Sushira** : One more new chemical viz. sushira has been developed at this Institute as a surface active wetting agent which is used as bagasse Pol and Moisture Reducer in the sugar factories. It has been also being commercialised through the National Research Development Corporation, New Delhi. This chemical has been used extensively in the various sugar factories. By the use of 'Sushira' the mill extraction is increased by 2-2.5 units.

The pol percent bagasse is reduced by 0.5 to 0.8 units.

Recovery is increased by 0.10 - 0.18 percent on cane and the moisture percent bagasse decreases by about 1-3 units. The patent right has now been transferred to the firm in Delhi for manufacturing and marketing.

(iii) Rectangular Resistance Heater for heating of Final Masecuite

The Institute has invented an equipment named Rectangular Resistance Heater for reheating of Final Masecuite to reduce the viscosity and thereby better purging and reduction in recirculation of molasses. The present invention refers to the development of a new design for electrical resistance heater for heating final masecuite from 40-42° to 52-54° with minimum residence time and with minimum head loss due to friction at the designed flow rate. It is electrically safe and low in cost and maintenance. The equipment is free from spark discharges and localised charring of the masecutes.

(j) Production of Yeast from Molasses

A process for the manufacture of yeast from sugar factory waste molasses has been evolved. The process to be adopted is differential formation of cane waste molasses using ammonia. It consists of four stages : (a) pre-treatment of molasses, (b) Incremental development of seed yeast, (c) Main formation under heavy aeration condition and (d) Yeast cream recovery.

National Sugar Institute has conducted several runs of the process for the production of Baker's Yeast cream and Tourls Yeast for protein food. M/s Dhampur Yeast Co., Dhampur (U. P.) has started manufacturing the Baker's yeast as per our design and process.

(k) Process for the Treatment of Distillary Effluents

The National Sugar Institute, Kanpur has worked out a method in which the effluent from a distillary is subjected to treatment by ammonifying bacteria, whereby it has been possible to bring down the B.O.D. value from about 15,000 to about 2,500. This is achieved by first preparing a culture of ammonifying bacteria and then acclimatising the same to the spent wash. This is done in a series of tanks occupying almost 1/10th area normally occupied by agoons. The exhaustion of B.O.D. from about 15,000 to about 2,500 is brought about in 3/4 days time by the action of ammonifying bacteria in the diluted spent wash. Evolution of Ammonia takes place in the process and the acidity of the effluent gets considerably reduced. This treated effluent can now be diluted further and let into fields for the action of nitrifying bacteria which are present in the soil, whereby the nitrogen in the spent wash becomes available to the soil. Thus, not only the entire quantity of potassium salts, but also the nitrogenous matter present in the spent wash becomes

available to the soil as a microbial fertilizer.

Technical Advice and Assistance

The Institute has played a great role in the development of the sugar industry in India. From almost a scratch in 1932, the industry has developed today a production capacity of about 5.0 million tonne of sugar at a fairly high level of efficiency. The Institute has endeavoured to provide to the necessary technical know-how and has by its advisory work and various other activities been helpful in improving the quality and recovery of sugar and in supplying specification for new plants and extension of the existing ones.

The Institute provides technical assistance to the industry through the following means :

(a) Technical officers and staff of the Institute are deputed to sugar factories on payment of prescribed fees for giving technical advice and investigation of problems on the spot. Advice is also given by correspondence and by personal discussions at the Institute for which no fee is charged.

(b) Improved design of various equipments used in the sugar factories complete with their manufacturing details and diagrams are prepared and supplied to the factories on payment of prescribed fees. Modified drawings of the existing equipment of the factories as suggested by the advisory officers during their visits are also prepared and supplied to the factories alongwith their visit reports.

(c) Advice is given to promoters of new factories and for expansions and materials used in sugar industry are carried out.

(d) Inspection of existing machinery is also carried out.

(e) analysis of samples of sugar and sugar products and chemicals and materials used in sugar industry are carried out.

Extension Service Division

It makes available to the Industry the accumulated knowledge, of the Institute through a team of experts in Sugar Technology, Sugar Engineering and Chemical Engineering etc. The team comprising of Senior Experts in Sugar Technology, Sugar Engineering Chemical Engineering, Instrument Engineering etc., with the appropriate staff makes a detailed on the spot study and investigation and draws up a detailed survey report including advice, suggestions, long and short term recommendations covering all aspects or any particular field of aspect of the factory working and equipment with a view to enable the factory to

achieve efficiency and economy at every stage of production.

The different types of services that are rendered under this Division and the scheduled fees for each of them are as follows :

(i) Comprehensive Survey

Comprising of two visits by the extension service team viz., the preliminary survey (5-6) days and the final survey (8-10) days covering all technical aspects in respect of Factory working equipment, layout, fuel and steam economy modernisation, balancing expansion, etc. This service can be achieved of by paying the lump sum fees of Rs.17,000/- in two instalments viz., Rs.11,000/- in the beginning followed by another Rs.6,000/- after the preliminary survey but before the final survey.

(ii) General Check-up

Comprises of a single visit by the team and covering all technical aspects of factory working, equipment, balancing, expansion, fuel and steam economy etc. The lump sum fee for this service is Rs.8,000/- payable in advance.

(iii) Fuel and Steam Economy Check-up

Comprises of single visit (5-7) days and covering all aspects of fuel and steam problems of the factory including the actual measurement of total steam production and the corrective steps for solving the fuel problem. The lump sum fee for this service is Rs.8,000/- payable in advance.

(iv) Expansion and Balancing of the Factory

Comprises of a single visit by the team covering all aspects of factory's expansion and balancing problem, its layout and modernisation. The fee for this service is Rs.8,000/- payable in advance.

(v) Milling Efficiency Check-up

Comprises of a single visit covering all aspects of milling efficiency to reduce the sugar loss in bagasse to the minimum. The fee for this service is Rs.6,000/- payable in advance.

(vi) Advice in respect of lay-out of various exhaust and live steam pipe lines, water and juice pipelines and their appropriate sizes are also available on payment of a scheduled fee of Rs.3,000/-.

(vii) Semi-Electrification Advice

Available for a schedule fee of Rs.3,000/- and covers advice in respect of gradual semi electrification of the plant.

(viii) Survey of sugar cane crop to draw cane supply on Maturity Basis

Under this service technical guidance is provided to a number of factories by the Institute experts in conducting survey of standing cane crop with a view

to assess the relative maturity of the crop in the different cane fields so as to recover the maximum sugar from the cane by way of preparing harvesting schedule on the basis of maturity as recorded at the time of survey.

This service is available for a scheduled fee of Rs. 7,000/- per factory.

(ix) Treatment of Sugar Factory Effluents

This is also amongst the new services that have been incorporated in the scheme and is extended for advising the sugar factories on the proper treatment of their effluents which may create serious problems on public health if discharged as it is. The fee for this is Rs.2,500/- per factory.

Survey and Information Service

Technical and general enquiries relating to various aspects of sugar and its allied industries received from sugar factories, private parties and Government Departments are attended to. All technical and statistical data of importance to the sugar industry collected, compiled and disseminated to the sugar industry and all concerned.

Technical statistics and important research and general activities of the Institute are disseminated through the following publications for the benefit of research workers, sugar factories, Government Departments, traders etc.

<u>Publication</u>	<u>Periodicity</u>
1. Institute's Journal 'SHARKARA'	Quarterly
2. N. S. I. News Bulletin	Quarterly
3. Review of quality of sugar produced by Indian factories	Annual

Bureau of Sugar Standard

The Institute also issues the Indian Sugar Standards which were evolved by Institute for grading sugar in terms of its colour and grain size. Sugar is commercially graded and priced on the basis of these standards and these are prepared and supplied every year to sugar manufacturers and other users. The disputed sugar samples are also graded in terms of the Indian Sugar Standards.

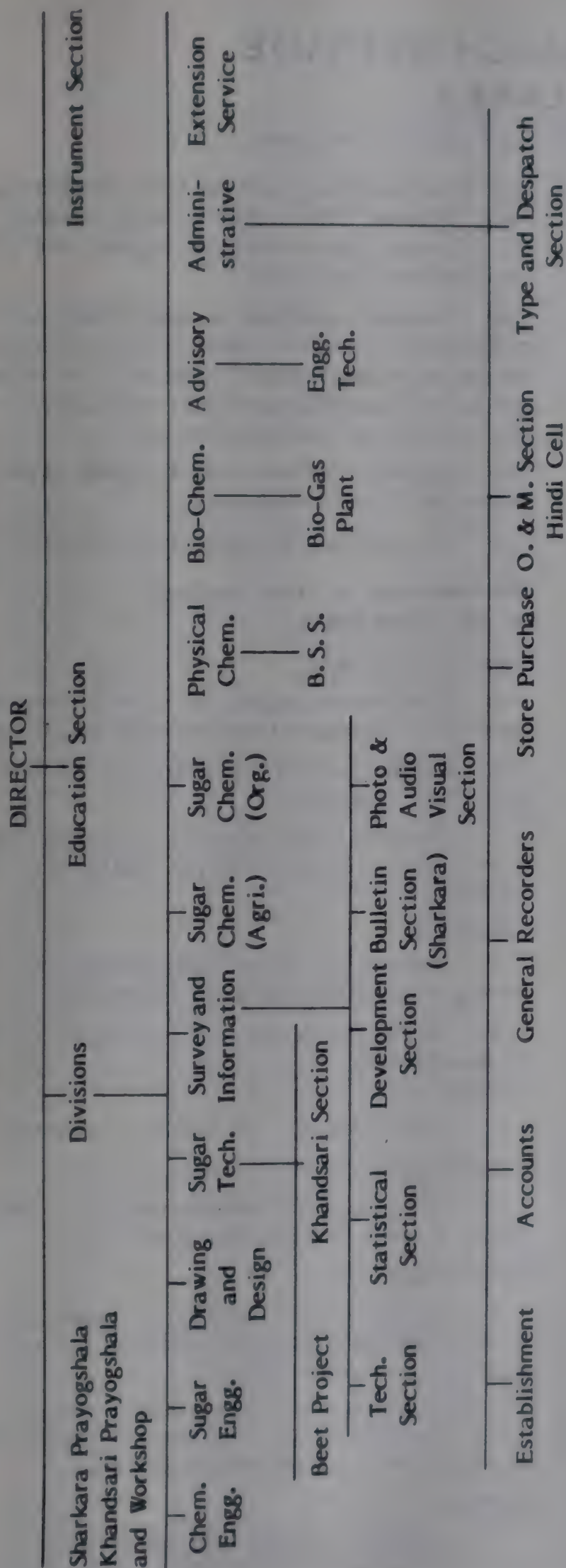
Instrumentation and Instruments Repair

The Institute has a well equipped instrumentation laboratory where overhauling, repairing as well as Calibration/Standardisation of various types of apparatus and instruments used in the sugar factories are done on payment. The Institute also advises the Industry on aspect of Instrumentation.

Supply of Cultures

The Institute prepares and supplies Scheduled Cultures of various aspects to distilleries and other organisations on payment of Rs.60/- per culture.

Organisational Set Up of National Sugar Institute, Kanpur



Annexure II

Courses of Instructions

- (i) **Regular Courses**
- (a) Post Graduate Diploma Course of Associateship of National Sugar Institute in Sugar Technology (A.N.S.I.)
- (b) Post Graduate Diploma Course in Industrial Fermentation and Alcohol Technology (D.I.F.A.T.)
- (c) Post Graduate Diploma Course of Associateship of National Sugar Institute in Sugar Engineering (A.N.S.I.)
- (ii) **Short Courses**
- (a) Certificate Course in Sugar Engineering
- (b) Certificate Course in Sugar Boiling
- (c) Certificate Course in Pre-harvest Cane Maturity Survey
- (d) Certificate Course of Khandsari Supervisors
- (e) Certificate Course for Khandsari Karigars (Artisan)

Personnel

1. Professor Ram Kumar, Director
2. Shri J.C. Bhargava, Professor of Sugar Technology
3. Shri J.S. Mehta, Chief Technologist (Advisory)
4. Dr. A. P. Gupta, Professor of Sugar Chemistry (Agriculture)
5. Dr. L. Vishwanathan, Professor of Biochemistry
6. Shri M. U. Ovaisi, Chief Technologist (Extension)
7. Shri H. N. Gupta, Chief Design Engineer.
8. Shri R. K. Vaish, Professor of Sugar Engineering
9. Shri N. K. Malhotra, Chief Engineer (Advisory)
10. Dr. K. A. Prabhu, Professor of Sugar Chemistry (Organic)
11. Shri Y. K. Jain, Professor of Chemical Engineering
12. Dr. M. Prasad, Professor of Physical Chemistry
13. Shri R. B. Nigam, Chief Chemical Engineer.

SUGARCANE RESEARCH INSTITUTE OF SRI LANKA

207, Esther Avenue, Off Park Road, Colombo 5, Sri Lanka

Sugarcane Research Institute of the Ministry of Agricultural Development and Research was established by Act of Parliament of Sri Lanka, No. 75 of 1981 and was inaugurated on 29th April 1983.

Aims & Objectives

The main purpose of the Institute is to conduct research on the Cultivation, Processing, By-products utilisation of sugarcane and to cater to the training needs of the sugar industry. It has a Research Station at Walawe (Southern Province), with Field Stations at Kantale & Hingurana (Eastern Province). A Quarantine Farm is maintained at Gannoruwa (Central Province) in collaboration with Central Agricultural Research Institute.

Chairman : Dr. R. L. Wickremasinghe
B.Sc.(Ceylon), B.Sc.(London)
Ph.D. (Sheffield), P.I. CHEM, C.CHEM.

Director

Director : Dr. Nande Dharmawardene
B. Sc.(Ceylon), Ph.D.(Dundee)

Divisions

There are eight Research Divisions located at Walawe. Agronomy Division is concerned with the general agronomy of sugarcane. Breeding Division is responsible for hybridization, initial selection, provision of certified seed material varietal introduction and tissue culture programmes, of promising clones as well as introduction of new varieties. Chemistry Division is concerned with soil plant nutrition and sugar chemistry. Engineering Division handles farm mechanization and irrigation aspects of sugarcane cultivation. Entomology Division handles the sugarcane pest control programme. The major areas of concern at present are biological control of insect pest and the control of Nematodes. Microbiology Division is concerned with the sugarcane diseases, disease regulation and fermentation technology based on molasses.

Training Division is concerned with training, seedcane management and extension aspects. Biometry Division is a service division to cater to needs of data processing. In addition, it carries out its own investigations.

The role of the Institute

The role, Sugarcane Research Institute has to

play in the next five years has been identified as follows:

(a) Provide the industry with suitable varieties for different agro-ecological regions and provision of certified seed materials.

(b) Provide appropriate agronomic practices for cultivation of cane under irrigated and rainfed conditions, advice on the appropriate level of farm mechanization and develop suitable machinery especially to facilitate planting and harvesting operations.

(c) Evolve a suitable training programme to cater to the needs of the industry.

(d) Development of sugarcane By-products.

Achievements of the Institute for past three years

Sugarcane Breeding

1. Continuous supply of locally bred sugarcane varieties (K varieties) to the commercial plantations.

2. Introduction of commercially proven varieties from other countries.

3. Usage of tissue culture as an innovative breeding technique to develop better performing sugarcane varieties.

Agronomy

1. Introduction of minimum tillage and pre and post emergent weed control using chemicals.

2. Recommendation of varieties suitable for ill drained soils.

Biometry

Determination of yield forecasting method.

Engineering

Designing and construction of a deglumer to separate seeds of sugarcane from fuzz.

Entomology

1. Studies on the biology of major juice sucking insects (leaf hoppers, mealy bugs etc.) to adopt suitable biological control measures.

2. Studies on the biology and level of damage by seed sett destroying termites in rainfed plantation to adopt chemical methods of control.

Pathology

Isolation, culture and identification of ratoon stunting disease bacteria found in sugarcane of Sri Lanka.

DECCAN SUGAR INSTITUTE

Manjari (Bk.) 412 397
Tal. Haveli, Dist. Pune

The Deccan Sugar Institute was established in 1975, based on the recommendations of the Ramakrishna Committee constituted by the Government of India to examine the feasibility of establishing regional sugar research institutes. Under the auspices of the Maharashtra Rajya Sahakari Sakhar Karkhana Sangh Ltd., Bombay, which is a Federation of Co-operative Sugar Factories in Maharashtra and a constituent member of the National Federation of Co-operative Sugar Factories, the Institute was registered under the Societies Registration Act 1860 and also under the Bombay Public Trust Act 1950. The Project Office of the Institute was started on 11.11.1975 at Pune and functioned under the able guidance of the world famous Sugar Technologist, late S. N. Gundu Rao. Thereafter, the two-winged massive laboratory building and students' hostel buildings were constructed, the Institute started operating from Manjari Bk. i.e. from the year 1983 onwards.

The Institute is governed by Board of Trustees comprising the following members :

- (1) Shri Vasantraodada Patil,
Chief Minister of Maharashtra
- (2) Shri Yeshwantraoji Mohite, M. P.
- (3) Shri Shankarraoji Kolhe, M. L. A.
- (4) Shri Ratnappa Kumbhar
- (5) Shri V. A. Kore
- (6) Place vacant.

and the Governing Council consisting of 25 members having the following composition :

- (1) 6 Trustees
- (2) 3 Representatives of Government of Maharashtra
- (3) The Chairman, Maharashtra Rajya Sahakari Sakhar Karkhana Sangh Ltd., Bombay.
- (4) The Managing Director, Maharashtra Rajya Sahakari Sakhar Karkhana Sangh Ltd., Bombay.
- (5) The Director, Deccan Sugar Institute (ex-officio)
- (6) 3 Experts from the field of Science and Technology nominated by the Council.
- (7) 10 Members representing the sugar factories and their Federations and Associations in the area of operation.

The Aims and Objects of the Institute

(i) To carry out time-bound and result oriented research on various problems mainly related to the following divisions and to impart the results thereof to member co-operative sugar factories.

- (a) Sugarcane production and development
- (b) Sugar production
- (c) Engineering in sugar factories
- (d) Instrumentation.

(ii) To carry out research on the utilisation of the by-products of the sugar factory including trials of known or evolved processes on pilot plant or commercial scale.

(iii) To provide technical services such as advisory and extension services, repairs and maintenance of instruments and survey and information services to member sugar factories.

(iv) To provide teaching and training for the various disciplines such as below :

- (a) Scientific methods of sugarcane cultivation
- (b) sugar technology
- (c) sugar engineering and instrumentation
- (d) sugar industry management
- (e) and other required disciplines.

The estimated initial capital cost of the entire project would be approximately Rs.22.00 crores and the estimated annual expenditure would be around Rs.1.25 crores when the project is completed. As at present only the abovementioned buildings have come up. The construction of Workshop building is almost completed. Construction of two additional laboratory buildings is in progress. So also 55 tenement quarters in housing complex are under construction.

The management of the Institute vests in a Board of Trustees headed by Padmashri Vasantrao Dada Patil, Governor of Rajasthan and in a Governing Council comprising 25 members including three representatives of the Government of Maharashtra and three experts from the field of Science & Technology, viz. Director of National Chemical Laboratory, Pune, Vice-Chancellor of Pune University and the Director of National Sugar Institute, Government of India,

Kanpur. The administrative functions are carried out by Dr. D.G. Hapase, Director, who is a Sugarcane Specialist and who has many remarkable achievements to his credit and Shri Hambirrao Mohite, Chief Executive, who is a Law Graduate and is having more than 30 years administrative and executive experience with varied knowledge in cooperative processing, sale-purchase and Engineering fields.

The Institute is at present conducting the following courses :

- (1) Sugar Technology Diploma Course
- (2) Sugar Engineering Diploma Course
- (3) Sugar Engineering Certificate Course
- (4) Sugarcane Development Diploma Course
- (5) Sugar Instrumentation Technology Diploma Course
- (6) Alcohol Technology Diploma Course
- (7) Micro-processor and Computer Control systems to Sugar & Allied Industries.

The diploma awarded by this Institute is considered and recognised as equivalent to the diploma of National Sugar Institute, Kanpur.

The Institute has so far trained three batches, each of Sugarcane Development, Sugar Technology, Sugar Engineering Diploma and Sugar Engineering Certificate course students, among which were four Kenyan and three Tanzanian students who passed out of this Institute.

The Electronic Commission, Government of India, New Delhi has sanctioned a grant of Rs.9 lakhs for a project proposal submitted by the Institute for development of an Electronic Engineering Research Laboratory to train sugar industry personnel out of which a sum of Rs.4.5 lakhs has already been released on 18.4.1986. For the present the Laboratory is equipped with Electronic Microprocessor, Electronic Testing & measuring Instruments and Computer facilities under suitably controlled climatic conditions. Besides imparting training in digital and micro-processor based systems to ADSI students in Sugar Technology and Engineering, a separate full-time 2 years diploma course is started from the academic year commencing from July 1986.

Apart from the recent grant given by the Electronic Commission, the whole capital cost and running expenditure of the Institute is being financed from the donations/contributions received from the co-operative factories in Maharashtra State.

Site of Institute/Project

The Institute has purchased 140 acres of land at Manjari (Bk)., Tal. Haveli, Dist. Pune from the Government of Maharashtra, a place approximately 20 kms away from the Pune City.

The Institute is also having a land measuring 285 acres at Naigaon, Tal. Haveli, Dist. Pune (which is also purchased from the Government of Maharashtra) a place approximately 30 kms away from Pune City which land also shall be used by the Institute for its research and development activities.

The Institute also proposes to undertake a joint sugarcane research and development programme in cooperation with the Mahatma Phule Agricultural University, Rahuri on University's land measuring 122 acres at Manjari, Tal. Haveli, Dist. Pune, a place approximately 18 kms away from Pune City.

Project Cost

The cost of completing the Institute project has been worked out by the Architects of the Institute to be Rs.183.8 millions as of today. The total Capital Expenditure for the project has been worked out as under :

	(Rs.in Millions)
1. Cost of land development including roads & drainage	10.5
2. Cost of Main Complex including Laboratories, Auditorium, R&D Workshop etc.	100.00
3. Cost of Hostel Complex Buildings & Stadium and other Amenities	40.8
4. Cost of staff colony buildings market etc.	38.9
5. Cost of Furniture Equipments and Apparatus etc.	30.3
Total	220.5

INDIAN SUGAR MILLS ASSOCIATION

39, Nehru Place,
NEW DELHI 110 019

Tel: 6416601, 6416711, 6418618

Indian Sugar Mills Association, an all India Organisation of Sugar Industry, was established in 1932 when tariff protection was granted to the industry. It is recognised by the Central and various State Governments as the Central Organisation to voice the cause of the industry. All the sugar mills in the joint stock and public sectors are its members now.

It has a widespread organisation and maintains intimate contact with all regions in India through a net work of Regional Associations. It is represented on all important Government and other agencies connected with industry and trade in particular. It represents to Government on matters relating to sugar policy, fixation of sugar and sugarcane prices etc.

The main objects of the Association are as follows :

- (a) Protecting and Promoting the interests of its members in particular and the sugar industry in general.
- (b) Encouraging friendly feelings and promoting harmonious relation between employers and workers and the industry and cane growers.

With the passage of time, particularly ever since independence, the activities of the Association have been expanding so as to cope with the increasing problems arising from time to time and having a vital bearing on the growth and development of this industry as also on the socio-economic necessities.

It was entirely at the initiative of the Association that India entered the export market for sugar and has now carved a place for itself in the export map. It was in 1957, for the first time, the Association undertook export of sugar in sizeable quantities.

It was again at the initiative of the Association that the Export Promotion Act was enacted and the Association was nominated as the Export Agency under the Act.

Subsequently, the Association jointly with National Federation of Cooperative Sugar Factories Ltd., formed a separate body, under the name and style of ISIEC Ltd., to handle sugar exports which still continues.

Again with decontrol in 1978, Government gave up the system of monthly releases which caused a crash in sugar markets and factories were put to serious losses. It was at the instance of the Association that a voluntary agreement was concluded whereby the monthly releases from factories in all the sectors were regulated which greatly helped the industry.

During 1979-80 season when due to steep decline in sugar production the availability of levy sugar was inadequate to meet the actual requirement for public distribution system, the Association came forward and offered to Government to give free sugar as levy sugar during the months of October/November on replacement basis to avoid any inconvenience to avail their quota against ration cards.

As a measure of Rural Social Welfare, in line with Government's 20-Point Programme, a special Committee known as the Rural Development Sub-Committee has been formed to provide guidance to member-factories for the implementation of the rural development work.

The Association renders many useful services to its constituent members. Thus they are recommending authority for distribution of scarce raw materials. They represent industry in labour matters in tripartite discussions and render expert advice on matters connected with labour laws. It also represents members before the conciliation officers, labour courts and industrial tribunals.

The Association brings out numerous publications such as a monthly journal, a year book etc. to keep members abreast of development in the industry and to furnish them upto date data about the industry.

SUGAR TECHNOLOGISTS ASSOCIATION OF INDIA

P. O. : NSI, KANPUR 208 017 (U. P.)

The Sugar Technologists Association of India was started in 1925 and Late Mr. Noel Deerr was its founder President. The following are the aims and objects of the Association :

(a) To promote increase of the knowledge of the Science and practice of sugar technology for persons following or studying for the profession and other kindred branches of science.

(b) To grant certificates for competency in professional knowledge by issuing certificates for membership of the grades of Associates and Fellows either by election or by examination or otherwise.

(c) To provide opportunity for exchange of knowledge amongst the members to give facilities for the reading papers and delivery of lectures on subjects interesting to the profession and for the acquisition and dissemination connected with and useful to the profession by holding scientific discourses conventions seminars or symposia, by conducting study tours, by sponsoring delegation and taking part in conferences or conventions in India or abroad.

(d) To establish and maintain a library, farm or any or all of these and to print, publish and circulate papers, books, journals, magazines, periodicals and other technical and scientific literature and matter connected with the profession.

(e) To look after the interests of the members of the Association to bring about a standard of professional conduct to maintain employment bureau and secure better employment conditions and to strive for general betterment of their knowledge.

(f) To serve as an authoritative professional body on all matters pertaining to the profession of Sugar Technology.

The affairs of the Association are run by a Council elected in two years by its own members. The Council is assisted by Standing Committees on research, investigations, publications, off-season Employment and Uniform System of Chemical Control. The Indian National Committee of ICUSMA (International Committee for Uniform Members of Sugar Analysis) is attached to this Association. This Association is a corporate member of the International Society of Sugar Cane Technologists (ISSCT) which triannually meets in different part of the world.

The Association holds its Annual Convention, where technological papers on Sugar Cane-Agriculture Sugar Manufacture, Sugar Engineering and By-products, are discussed and the proceedings are published. This Association also conducts seminars at different places in India on various important subjects. Besides this, refresher course, workshop and training programme of the technicians and technologists are arranged.

The Sugar Technologists' Association of India offer the following awards to encourage contributions of original papers :

(i) "The Noel Deerr Gold Medal" is awarded for the best original paper of the proceedings (open to members of the Association only).

(ii) "Sugar Technologists Association's Silver Medals" are awarded to the best paper in each section viz. (a) Agriculture, (b) Engineering and Chemical Engineering, (c) Manufacturing, (d) Chemical Control and Analysis, (e) General and By-product (open to members of the Association only).

(iii) "Indian Sugar Industry" is awarded to an author of second best paper published in the proceedings (open to members and non-members of the Association).

These awards are made at the Annual Convention of the Association.

The Sugar Technologists' Association of India also brings out the following journal/periodical, which have a very wide coverage and reach the tables of the Managements of Sugar Factories, Technicians, Agricultural Scientists, Engineers, Technologists, Research Stations, Government Officials and various dignitaries connected with sugar and allied industries.

(a) Annual :

1. Annual Conventions Proceedings;
2. Year Book and Directory of Indian Sugar Factories.
3. List of Cane Sugar Factories & Distilleries in India.
4. Proceedings of the Technical Seminars.

(b) Bi-monthly :

Sugar Abstract.

Council of the Association**(1984 - 85 - 86)**

President	: Daya Prasad Tiwari
Vice-	: M. G. Joshi
Presidents	: R. Nandagopal
Hon. Treasurer	: A. C. Raha
Hon. Editor	: N. R. Khariawala
Council Members	:

N. N. Joshi, K. H. Rao, K. N. Sharma, N. C. Jain, V. N. Patil, H. A. Shah, G. N. Bansal, V. S. Patil, B. S. Gurumurthy, K. S. Shah, T. S. Thiyagarajan, P. R. alias Appasaheb Nalawade, C. M. Prasad, G. Ramachandran, A. P. Chinnaswamy.

Executive Secretary : M. K. Sharma

Publication : A. C. Raha

Advisory Committee : N. R. Khariawala.

THE SOUTH INDIA SUGAR CANE & SUGAR TECHNOLOGISTS' ASSOCIATION

222, IV Avenue, Indiranagar,
MADRAS 600 020

Tel: 411 203

This is an Association consisting mostly of Sugarcane & Sugar Technologists in the States of Orissa, Andhra Pradesh, Karnataka, Tamilnadu, Kerala and Pondicherry. There are at present 644 Life Members and 27 Ordinary Members. The Sugar Mills in these States are also Companion members. The object of the Association is to develop the technology both in the field and in the factory. The Association holds periodical Seminars, invites highly technological Scientists for delivering lectures and shares technological information between the members. The Association also publishes a quarterly technical journal under the name of 'SISSTA Sugar Journal' (Annual Subscription Rs.90 for non-members). The Association was established in 1968 and has a distinguished record of past Presidents and Secretaries. The present office bearers and their technical qualifications are as follows:

1. Shri A. P. Chinnaswamy
B.Sc., B.Sc. (Tech), A.N.S.I.
M.I.I. Chem., E., F.S.T.A. - President
 2. Shri K. S. Thirumalaiswamy
M.Sc. (Ag.) - Vice-President
 3. Dr. Gururaj Hunsigi
M.Sc. (Agronomy),
M.S. (Soils),
Ph.D. (Agronomy) - Vice-President
 4. Shri S. Kaliyamurthy
B.E. (Chem) - Hon. Secretary
 5. Shri T. B. Bharathi
I.A.S. (Retd) - Hon. Registrar -
Council Member
Editor of the
SISSTA Journal.
-

THE DECCAN SUGAR FACTORIES ASSOCIATION

Stadium House, Block No. 2, Veer Nariman Point, Marine Lines, BOMBAY 400 020
Tel: 221783

The Deccan Sugar Factories' Association represents all the 11 joint-stock sugar factories in Maharashtra and one joint-stock sugar factory in Karnataka. The main objects of the Association are to promote, project and safeguard the interests of the sugar industry and sugar trade, especially in Maharashtra; to encourage friendly feelings and unanimity amongst the members, good relations between employers and employees; to collect, compile and circulate statistics, market report, etc. to undertake or to provide facilities for exploration, experimentation,

analysis and/or other activities in the field of research pertaining to sugarcane, sugar etc.; to urge or oppose legislative and other measures and to procure change of law and practice affecting trade, commerce and industry; to adjust controversies between members of the Association; to regulate and control, whenever necessary, sales and prices of sugar produced by member factories, etc.

Shri D.C. Agashe is the President, Shri P.M. Kavadia, the Vice-President and Shri R. Venkataraman, the Secretary of the Association.

INDIAN SUGAR & GENERAL INDUSTRY EXPORT IMPORT CORPORATION LTD.

21, Community Centre, East of Kailash, New Delhi 110 065

- | | |
|---------------------------|---------------|
| 1. Shri Dhruv M. Sawhney | Chairman |
| 2. Shri Indubhai C. Patel | Vice-Chairman |
| 3. Shri J. S. Mehta | Secretary |
| 4. Shri S. S. Raina | Manager |

Indian Sugar and General Industry Export Import Corporation Ltd. (formerly : Indian Sugar Industry Export Corporation Ltd.) was incorporated in August, 1969 under the Companies Act, 1956 as a Company limited by guarantee with its Registered Office in the Union Territory of Delhi.

This Corporation was formed jointly by the National Federation of Cooperative Sugar Factories Ltd. and the Indian Sugar Mills Association with a view to developing the sugar export of the country.

The main purpose of the Corporation is to handle export/import of sugar and/or other commodities, either as principal or as agents. Since 1974 it has been handling export/import of sugar as agents of the STC. The Chairman of the Corporation is by rotation i.e. the nominee of the National Federation of Cooperative Sugar Factories Ltd., is Chairman one year and nominee of the Indian Sugar Mills Association is the Chairman for the subsequent one year. The nominee of the other organisation then becomes the Vice-Chairman.

There are eleven representatives of the National Federation of Cooperative Sugar Factories Ltd. in the Committee of the Corporation.

U.P. STATE SUGAR CORPORATION LTD.

25-B, Ashok Marg, Lucknow 126 001

U. P. State Sugar Corporation was incorporated as a Government Company under the Companies Act on 26th March, 1971. As per U. P. Sugar Undertakings Acquisition Act, 1971, twelve scheduled undertakings, mentioned hereunder, were acquired and vested in the Corporation with effect from 3rd July, 1971.

- | | |
|------------------|-----------------|
| 1. Barabanki | 7. Burhwal |
| 2. Sakhoti Tanda | 8. Ramkola |
| 3. Khadda | 9. Rampur |
| 4. Bhatni | 10. Amroha |
| 5. Mohiuddinpur | 11. Bijnor |
| 6. Jarwal Road | 12. Lakshmiganj |

The factories mentioned from serial 1 to 5, were transferred to Sugar Corporation immediately and those from serial 6 to 12 could be transferred only in 1979 after the vacation of stay orders; another unit, i.e. Pipraich, District Gorakhpur (13) was purchased in auction in June 1974.

Most of the above mentioned sugar factories were set up in the 1930s having capacity as low as 400 to 1000 TCD. With the rapid advancement of technology in sugar industry, these units at the time of take over had become obsolete & uneconomical. So much so, that these units were on the verge of closure on account of non-payment of cane price, labour dues, Government Taxes etc. Keeping in mind the interests of farmers and labourers, the Government was forced to take over these units.

Again by U. P. Sugar Undertakings (Acquisition) (Amendment) Ordinance, 1984, following twelve more units acquired and vested in the Corporation with effect from 28th October, 1984 :

- | | |
|-------------|------------|
| 14. Doiwala | 20. Maholi |
|-------------|------------|

- | | |
|--------------------|-----------------|
| 15. Maliana Meerut | 21. Munderwa |
| 16. Rohana Kalan | 22. Siswa Bazar |
| 17. Bulandshahr | 23. Chhitauni |
| 18. Bareilly | 24. Ghughli |
| 19. Saharanpur | 25. Hardoi |

The circumstances and state of affairs of these units, which resulted in takeover, are more or less same as mentioned in the case of earlier 12 units acquired. Thus it is amply clear that the Corporation has been burdened with the running and managing of the sick units.

In addition to the above 25 units, the Corporation established the following new sugar factories and the same are being managed through four subsidiary Companies :

- | |
|---|
| 26. Kichha Sugar Co. Ltd., Kichha |
| 27. Chandpur Sugar Co. Ltd., Chandpur |
| 28. Chhata Sugar Co. Ltd., Chhata |
| 29. Nandganj-Sihori Sugar Co. Ltd., Chhata |
| 30. Nandganj-Sihori Sugar Co. Ltd., Unit Nandganj |
| 31. Under erection at Ghatampur in Dist. Kanpur Dehat |

Board of Directors

	Tel(O)
Dr. V. K. Saxena, Chairman	46021
Sri K. K. Jaiswal, Managing Director	47072
Sri S. K. Tripathi, Director	48405
Secretary, Sugar & Cane Development	
Sri L. R. Singh, Director	45031
Cane Commissioner	
Dr. Gaur Hari Singhania, Director	
Sri Omkar Chatterjee, Director (IRBI nominee)	
Sri R. L. Srivastava, Director (IFCI nominee)	
Sri Sushil Mohan, Joint Managing Director	47072
Sri R. A. Prasad, Joint Managing Director	42305

DECCAN SUGAR TECHNOLOGISTS ASSOCIATION OF INDIA

17/1, Shivajinagar,
PUNE 411 005

Tel : 58575

History & Objects

The Deccan Sugar Technologists' Association was founded in the year 1936 by Sheth Lalchand Hirachand, an eminent industrialist from the famous Walchand family, closely associated with the sugar industry. The DSTA is a body of sugar and sugarcane technologists, progressive farmers, sugar factory managements and all those who are interested in the promotion and development of sugar industry. It was found that sugar industry in the Deccan had specific problems, both in field and factory, totally dissimilar to those of the sugar industry in Northern India. These problems required special attention and experimentation. Moreover, Deccan Region being in the tropics, its soil and climatic conditions were quite different from those in Northern India, which is a subtropical area. The DSTA is primarily concerned with the problems of the sugar industry of the Deccan Region. However, this Association is all along affiliated to the Sugar Technologists Association of India, Kanpur—a similar national body established in the year 1925 to study the problems of the Indian Sugar Industry.

Membership and Management

This Association has six category of members viz. Patrons, Life Members, Honorary Members, Companion Members (for Sugar Factories, machinery manufacturers, firms and other bodies dealing in sugar industry), Ordinary Members and Student Members. Patron members and Life Members are required to pay once and for all a sum of Rs.1,000/- and Rs.300/- respectively as membership fee. All other members are required to pay an annual fee as per prescribed scale. Ordinary members are required to pay a membership fee of Rs.20/- annually. The Companion members are required to pay Rs.1,250/- annually; and the Student Members are required to pay Rs.10/- annually. The Honorary Members are exempted from payment of all fees.

The management of the DSTA is vested in a Council consisting of the President, the Vice-Presidents, the Hon. Secretary, Hon. Joint Secretary, Hon. Treasurer, Registrar, immediate Past President, Retiring Honorary Secretary and one representative each from Companion member factories and from Maharashtra State Farming Corporation, Deccan

Sugar Institute and Maharashtra Rajya Sahakari Sakhar Karkhana Sangh. The Council is dedicated to improving the productivity and efficiency of the sugar industry in the Deccan and in this task it is assisted by a number of sub-committees viz. Agriculture, Engineering, Manufacturing and Bye-products, and Personnel which meet every two months and follow closely the various problems which confront the industry from time to time.

Activities

Since its inception this Association has been working in the interest of development of sugar industry and is especially engaged in disseminating knowledge in all the fields of sugar industry viz. Agriculture, papers at the seminars and during the Annual Convention, have proved to be highly useful to the sugar factories. The increasing utility of this Association has been recognized by the sugar industry. Consequently, the membership of the Association which stood at 454 in 1950 increased to 2422 as on 31.3.1986. The membership of 2422 comprises of 125 Companion Members, 71 Patron Members, 351 Life Members and 1875 Ordinary members including Student Members. The Membership is spread over not only in Maharashtra State but also in other States like Gujarath, Karnataka, Andhra Pradesh, Kerala, U. P., M. P., Goa etc. and also in foreign countries.

Sugar Engineering, Manufacturing, Bye-products etc. The member sugar technologists and scientists of this Association come together every year in an Annual Convention to discuss and review the technical work done by the individual members with a view to improve the practices followed in the sugar industry. It has been our experience that such discussions have been extremely helpful not only to the participating sugar technologists, but also to the sugar industry as a whole. Since the establishment of this Association, it is seen that the technical performance of all the branches of the sugar factory have been considerably improved and that the technologists have become more active in experimentation and research. The Association has been publishing all the technical work done by the individual technologists for the benefit of other technologists and the industry. This Association provides a free and open forum to sugar technologists to ventilate their ideas in respect of research work carried out by

them on any technical subject.

The DSTA has been organising Annual Conventions for more than three decades now. The last such Convention was the 36th Annual Convention held in 1986. In these Conventions, technical papers submitted by the various technologists on the basis of work done by them in the factories or the fields, were presented and discussed and the decisions arrived at were very closely followed by the technologists for the improvement of sugarcane cultivation and sugar manufacture.

Upto 35th Annual Convention as many as 1113 papers were presented for discussion, out of which 629 were on agricultural subject, 241 on manufacturing subjects, 139 on engineering subjects, 40 on bye-products of sugar and 64 on general type pertaining to sugar factory management and jaggery production. The Association has been able to collect massive research data pertaining to research in sugar and sugarcane development and this has helped our sugar factories to attain maximum efficiency in their working. In fact, the factories have been able to effect considerable economy in fuel consumption, increase their mill efficiency and reduce sugar losses in process.

At the time of the Annual Conventions as also on special occasions the Association organised nearly 71 seminars uptill now on various subjects where initially a background paper is presented and subsequently the discussions are also published. These seminars were of great value as they related to specific problems of process and introduction of new process and machinery in the sugar industry. The seminars on agricultural subjects were of great value to the cultivators as they were useful in development of cane area, especially in improving cane yield etc. and hence were well appreciated. The Association also organizes special meetings of cultivators and sugar factory managements whenever specific problems like irrigation difficulties, manuring problems, problems of scarcity and famine etc. arise. Another important activity of the Association is to organise study tours of foreign countries by technologists. So far, the Association has sent its technologists to Australia, Mauritius, Hawana, Venezuela, Taiwan and Phillipines.

The Association also organizes, from time to time, classes for the semi-skilled workers at the factories during off season, in Manufacturing and Engineering Sections. The Association has so far organized about 40 such classes for semi-skilled workers, which were found to be very useful for educating the workers. This activity is a regular feature of the Association. The work of preparing feasibility report for new sugar and khandsari units is also undertaken by the Association.

The Association has its own small building at a central location in Pune (opposite to Shivajinagar S.T. Stand) wherein its office is located. It has got a very good library having different important books on Sugar Industry including important journals received from foreign countries. For the present mid-time seminars organised by the Association in off season are held in the Hall of the Association, which is also given on hire to other Institutions, Banks, offices, etc. for holding their meetings. To support its rapidly expanding membership and activities and to enable it to hold its Annual Conventions, Seminars, etc. in its own building, it has been proposed by the Governing Council of the DSTA to extend the existing building and also to have a big auditorium, wherein about 1200 to 1300 persons can sit, to accommodate all its expanding activities and for holding Annual Conventions, Seminars, Group Discussions carrying out research work and making available to its members well-equipped laboratory and library. The proposals in this behalf have already been submitted to the Pune Municipal Corporation and in the meantime efforts are being made to collect the required funds for the purpose.

Every year, the Association holds its Annual Convention and General Body Meeting generally in the last week of August or in the month of September. The last such Annual Convention (36th Annual Convention) was held on 27th, 28th and 29th September, 1986 and the General Body Meeting was also held on the last day of the Convention. In the General Body Meeting, the following Office Bearers have been elected :

- | | |
|---|--------------------|
| 1. Shri Vishwanathrao S. Patil | President |
| (Chairman of Maharashtra Rajya Sahakari Sakhar Karkhana Sangh & Chairman of Sangli Sugar Factory) | |
| 2. Shri Ishvarbhai N. Patel | 1st Vice President |
| (Chairman, Shree Khedut Sahakari Khand Udyog Mandali Ltd., Bardoli, Dist. Surat, Gujarat State) | |
| 3. Shri Balasaheb Devram Wagh | 2nd Vice President |
| (Chairman, Karmaveer Kakasaheb Wagh Sahakari Sakhar Karkhana Ltd., Dist. Nasik) | |
| 4. Shri Uttamrao J. Phalke | Hon. Secretary |
| 5. Shri B. S. Vaidya | Hon. Jt. Secretary |
| 6. Shri C. V. Gupte | Hon. Treasurer. |

Shri D. M. Ravetkar continues to be Registrar of the Association.

THE BOMBAY SUGAR MERCHANTS ASSOCIATION

Ahmedabad Street,
BOMBAY 400 009

Tel: 323884

History

The Bombay Sugar Merchants Association was established about 76 years ago. The Association's building and all records were totally destroyed in the April 1944 Bombay Dock Explosion. To remedy the situation the Bombay Sugar Market Limited was formed on 18.11.1945. This Company constructed a new building and housed the office of the Association and also its trader member's offices and godowns which were lost in the explosion. This was carried out under the leadership of Seth Maneklal Ujamshi and a few leading traders of that time who restored to function the Bombay Sugar Merchants Association and secured for it the status of a body corporate representing the sugar merchants in the country in general and in Bombay in particular.

Objects

To ensure fair practices and dealings among its members and improving the image of the trading community in the face of the frequent periods of scarcity of sugar. For to realise these objects the Association nurtures goodwill towards the trading community by maintaining constant liaison with the industry, with State and Central Governments and also with the press.

Achievements

(1) In 1945 sugar was totally controlled commodity. As a result of BSMA's persistent and prolonged representations all the controls on prices and distribution of sugar were removed with effect from 8.12.1947.

(2) 'Indian Sugar Syndicate', a subsidiary body of the sugar mill owners was given monopoly rights in 1947 to procure sugar from the mills and sell the same to wholesalers. This arrangement was harmful to the interests of the trade and consumers, because the syndicate adopted undesirable means of overweighing and overcharging, misguided the Government in regard to the consumption trends and issued insufficient quotas for consumption, and worked mainly for the interests of the industry in a manner detrimental to those of the trade and the consumers.

The BSMA along with other associations of sugar merchants in the country, put up a strong caveat

not only against the policies of the syndicate, but also against very existence. As a result, in 1949, the 'Tariff Board' enquired into the affairs of the Syndicate and confirmed the allegations. Subsequently Government of India accepted the recommendations of the Tariff Board and withdrew recognition of the syndicate.

(3) With effect from 1st April, 1949 the then Government of Bombay levied sales-tax on sugar, under which many forms, returns and registers had to be filled in and maintained. This created a lot of difficulties and entailed heavy clerical work for the sugar trade. The Association persistently took up the case for the merging of sales-tax with the Central Excise Duty to facilitate collection and payment and also to obviate harassment. The Association relentlessly represented these problems to the State and Central Governments till 14.12.1957 when sales-tax on sugar was finally abolished and merged with central excise duty.

(4) In 1963 the State Government for the first time formally recognised the Association as an accredited body for distributing levy sugar under a scheme formulated by the Association and approved by the Government. This scheme was in force for nine years i.e. from 1963 to 1972. Substantial portion of levy and free-sale sugar allotted to Bombay was handled by the trade very commendably, effectively and to the satisfaction of the consuming public.

The BSMA became a truly representative body from the year 1978-79. Under the dynamic and able leadership of its Presidents, Shri Chandrakant T. Sanghvi and Shri Mohan Gurnani, the Association enunciated and brought about many programmes and projects of a constructive nature and received acclaim from both the authorities and consumers alike.

In pursuance of the social welfare activities envisaged for the Association as a body of sugar merchants, a charitable dispensary has been established, note-books are distributed to school going children of members employees every year at subsidiary rates. blood-donation camps are organised whenever possible

donations have been given to Lions Club of Mazgaon to set up a first-aid Centre at Matheran etc. What is also significant is that an Indian map showing locations of all the sugar factories has been published in addition to the earlier map of Maharashtra State, and this has been well received by all concerned and has proved to be a very useful guide.

The Association at present is represented in the Indian Sugarcane Development Council and is

legitimately proud of the fact that it has always risen to the occasion to fulfil its obligations to the Government and the consumers at large. It is indeed heartening to note that the sincerity of purpose of the Association and its members is well taken into account by the Union Food Ministry, the Government of Maharashtra and Controller of Rationing, who have always been considerate to its members and are extending full support to its members.

THE CAWNPORE SUGAR MERCHANTS ASSOCIATION

(Incorporated by Licence from Government
of Uttar Pradesh under the
Indian Companies Act)

51/56, Sitaram Market, Nayaganj,
KANPUR 208 001

Tel: 62255. Gram: SUGARASSO

Representatives on :

Indian Sugarcane Development Council,
Government of India Sugar Industry
Sectional Committee AFDC,
Indian Standards Institution, New Delhi
Kanpur Area Northern Railway Users'
Consultative Committee, Kanpur.

This Association is of sugar traders and was registered under the Indian Companies Act 1913 on 13th November, 1935.

The aims and objects of the Association are:

- (a) To encourage and foster the trade in sugar and safeguard the interests of the persons engaged in that trade.
- (b) To lawfully promote or oppose legislative or other measures affecting the sugar trade.
- (c) To collect and circulate statistics and other information relating to sugar.
- (d) To try for removal of difficulties of parties

engaged in Sugar trade and to obtain facilities for them in their trade.

- (e) To arbitrate and/or settle trade disputes arising out of dealings or transactions in sugar.
- (f) To establish such just and equitable principles in sugar trade as will facilitate and promote the trade in sugar and the interests of the parties engaged in Sugar trade.
- (g) To borrow funds for the purposes of the Association on such security as may be deemed fit.
- (h) To purchase or otherwise acquire any property for the purposes of the Association and to sell, give on lease, turn to account or otherwise dispose of, or deal with the property of the Association.
- (i) To invest the funds of the Association in safe and remunerative forms.
- (j) To do all such other lawful acts and things as may be incidental or conducive to the attainment of the above objects.

THE NATIONAL FEDERATION OF CO-OPERATIVE SUGAR FACTORIES LTD.

Vaikunth , 82-83, Nehru Place, NEW DELHI 110 019

Tel: 6412864, 6418660, 6417481

Gram : FEDSUCOP

The National Federation of Co-operative Sugar Factories Ltd., is an all-India organisation of the Cooperative sector of the sugar industry in India. It is recognised by the Central and State Governments, and has its office at 'Vaikunth , 82-83, Nehru Place, New Delhi 110 019. All the cooperative sugar factories in India including those under establishment, are its members. The Federation is represented on all important Government and other bodies connected with sugar industry. It represents to Government the view of the cooperative sector on all matters relating to sugar policy, fixation of sugar and sugar cane prices etc. Its aims and objects include: Coordinating and facilitating the working of the affiliated cooperative sugar factories and the state federations and to assist in the promotion of and organisation of new cooperative factories.

In pursuance of these objectives the National Federation of Cooperative Sugar Factories provides technical advice and other assistance on the selection and maintenance of plant and other equipment; advising and assisting the selection of technical personnel; suggesting measures for increasing the operational efficiency of cooperative sugar factories; and assisting to secure the necessary financial assistance from the Central and State Governments, the Industrial Finance Corporation of India, the State Bank of India and from such other financing agencies.

The Federation publishes a number of journals. Among them are : Cooperative Press News, a weekly; news bulletin containing news, articles, comments, statistics and market reports concerning the sugar industry and allied matters; publication of questions and answers on sugar in Parliament; a Cooperative Sugar Directory and Year Book which gives details of all sugar factories, their working results, sugar statistics and addresses of firms supplying stores for sugar factories. 'Cooperative Sugar' a monthly journal containing articles and statistics on sugar and its allied subjects.

State Federations

The National Federation of Co-operative Sugar Factories has the following State Federation units

as its members :

1. The Andhra Pradesh State Federation of Cooperative Sugar Factories Ltd.
1-1/140/A, Ashoknagar
Hyderabad 500 020
2. The Haryana State Federation of Cooperative Sugar Mills Ltd.
Kothi No. 110, Sector 8-A,
Chandigarh 160 008
3. The Gujarat Rajya Sahakari Khand Udyog Sangh Ltd.
9, K. B. Commercial Centre, 6th Floor,
Dinabhai Tower, Mirzapur Road,
Ahmedabad 380 001
4. The Maharashtra Rajya Sahakari Sakhar Karkhana Sangh Ltd.
'Sakhar Bhavan , Plot No. 230, Block No. 3,
Backbay Reclamation, Nariman Point,
Bombay 400 021
5. The Karnataka State Cooperative Sugar Factories Federation Ltd.
No. 34/2, 2nd Floor, 3rd Cross,
4th Block, Kumar Park West, Seshadripuram,
Bangalore 560 020
6. The Tamil Nadu State Federation of Cooperative Sugar Factories Ltd.
No. 2, Maharajasurya Rao Road, Alwerpet
Madras 600 018
7. The Punjab State Federation of Cooperative Sugar Mills Ltd.
SCO 128-129, Madhya Marg, Sector 8-C,
Chandigarh 160 022
8. The Uttar Pradesh Cooperative Sugar Factories Federation Ltd.
9-A, Rana Pratap Nagar
Lucknow 226 001
9. The Madhya Pradesh Cooperative Sugar Factories Federation Ltd.
Care Office of the Registrar,
Cooperative Societies, Madhya Pradesh
Vindhyachal Bhawan
Bhopal.

ANDHRA PRADESH STATE FEDERATION OF CO-OPERATIVE SUGAR FACTORIES LTD.

1 - 140 - 10/A, Ashok Nagar, Hyderabad 500 020.

Telegraphic Address ACOPSUFED, Hyderabad

Telex : APSK - 624

Telephones Office : 64052

Resi. : General Manager
62908

No. of factories affiliated 18

No. of working factories 17

The Andhra Pradesh State Federation of Cooperative Sugar Factories has the unique distinction of having as one of its members, the Etikoppaka Cooperative Sugar Factory which is the first project set up in the country as an experiment in the Cooperative Sector for sugar production. The Federation has been playing an effective role in the organisation and the proper development of the cooperative sector of the industry in the State. The contribution of the cooperative sector to the states production has been significant being over 25%.

From the very start, the Federation realised the importance of cane development in the success of the industry and has been taking measures for the development of quality cane. A retired sugarcane specialist of the State Government was appointed for a period of 3 years as the Agriculture Advisor of the Federation to advise the factories on proper cane cultivation practices. In the light of the financial assistance provided by the National Co-operative Development Corporation and to make itself more serviceable to the member factories, the Federation has engaged technical experts in the field of Sugar Technology, Finance and Agriculture. The Federation has a programme to economise the expenditure to the factories undertaking bulk purchase of important major items of consumables required by individual factories and also to keep liaison between the factories by supplying unrequired items of one factory to another factory in need and thereby reduce inventories.

Proposal to undertake sale of free sale quota on behalf of all factories at Federation level is under consideration. This is presumed to be helpful to the factories in reducing the expenditure and also fetch a reasonable and higher price.

The Federation has undertaken initiative in conducting technical and management seminars to discuss and solve specific and general problems of the Cooperative Sugar Factories in particular. Two such seminars were held at Sakkarnagar and Tirupati in the State during 1970 and 1971. The All India Technical Seminar of Cooperative Sugar Factories by the National Federation was held at Hyderabad in July 1976.

After the Technical staff had joined, the Federation had undertaken to train all the field men in the factories in the development of cane cultivation under the able guidance of the Director of Sugar. The Federation is undertaking shortly seminars and refresher courses for the Managing Directors, for the Accounts Staff, Engineers and Chemists of the Cooperative Sugar Factories through the Staff of Federation, Management Consultants and National Sugar Institute to make the Managerial and Supervisory staff of the factories more equipped in their field of activity.

Under the directions of Directors of Sugar, the technical staff of Federation has been more associated with the six factories that are coming-up in the fields of : finalisation of prices and agreement for supply of machinery, cane development programme, filling up Industrial Finance Corporation Loan Applications funds flow, progress of the factories for civil construction work, recruitment of staff and all matters for the establishment of these factories.

It can be said that Federation has gained the momentum compared the past years and under the leadership and guidance of the President and the Director of Sugar, the Federation will have good opportunities to serve the member factories and more in the near future.

THE HARYANA STATE FEDERATION OF CO. OPERATIVE SUGAR MILLS LTD.

100, Sector 8 - A, Chandigarh.

Telegraphic Address "SUGARFED" Chandigarh

Telephone No Office - 25654

Resi 21729

No. of factories affiliated 7

No. of working factories 7

The first cooperative sugar factory with daily cane crushing capacity of 1250 tonnes went into production in 1956-57 at Rohtak. The second factory was also commissioned in the same year at Panipat. The Panipat Sugar Mill also established a distillery in 1962 in order to make better use of its molasses and to meet the requirements of industrial spirit and alcohol in the state. The crushing capacity of both these cooperative Sugar Mills at Rohtak and Panipat was raised to 1750 and 1800 tonnes per day respectively during 1976-77 crushing season. Both these factories are carbonation plants. The other two sugar mills at Karnal and Sonapat

(crushing capacity 1250 TCD each) started crushing operations from the crushing season 1976-77. The Government of India has granted letters of intent to three new sugar mills at Shahbad, Palwal and Jind.

The Federation has established a promotional and technical cell to provide guidance towards the improvement of the efficiency of the member sugar mills. The present activities of the cell are centred around cane development and proper maintenance of accounts and cater to the technical need of the sugar mills for which a technical advisor had been appointed.

GUJARATH RAJYA SAHAKARI KHAND UDYOG SANGH LTD.

9, K.B. Commercial Centre, 6th floor,
Dinabhai Tower, Mirzapur Road,
Ahmedabad 380 001.

Telegraphic Address SUGARFED (Ahmedabad)

Telephone No. 391764, 393685

1. Shri Indubhai C. Patel Chairman

2. Dr. C.J. Patel Managing Director

No. of factories affiliated 15

No. of working factories 14

No. of factories affiliated 17

No. of working factories 16

The Federation has introduced a Turn-key Job System for the earlier commissioning of factory project at the same time with less cost which has been appreciated by all concerned.

Orders have been given on Turn-Key basis for two factories Zervavra Taluka, Mahuva District Surat and Talaja (Gir) Dist. Bhavnagar. Technical cell as per NCDC scheme started in 1977.

MAHARASHTRA RAJYA SAHAKARI SAKHAR KARKHANA SANGH LTD.

Sakhar Bhavan, Plot No. 230,
Backbay Reclamation, Block No. 3,
Nariman Point,
Bombay - 400 021.

Telex No.	011-4720
Telegraphic Address	"SAKARSANGH" Bombay
Telephone Nos.	2042901, 2042578, 2042676
1. Shri Shivajirao Patil	Chairman
2. Shri Ankushrao Tope	Vice - Chairman
3. Shri M.S. Marathe	Managing Director
4. Shri G.B. Ghorpade	Secretary
No. of factories affiliated	92
No. of working factories	87

THE KARNATAKA STATE FEDERATION OF CO-OPERATIVE SUGAR FACTORIES LTD.

34, III Cross, IV Block,
Kumar Park, West Extension,
Bangalore - 560 020.
Gram : MYCOSUFED

No. of factories affiliated	19
No. of working factories	17

The Federation had an humble beginning. Starting from only 3 members in 1961 it has grown from strength to strength and has today 26 members on its board

The scope of the federation has enlarged by leaps and bounds with regard to providing services on account of various facilities namely technical services from our Senior Sugar Technologist and Senior Sugar Engineer, appraisal and preparation of reports, accounts and other schedules and cash flow statements by the Financial Advisor and other liaison work with the various institutions situated both at Bangalore and Delhi and other places has been an uphill task and in order

to cater to this and to attend to day to day problems, it has become necessary for the Federation to keep abreast of member factories and to represent them at various forums regarding the problems faced by them in order to redress their grievances and also to find out the best and most suitable methods to mitigate their unsorted problems at different levels with the State and Central Government agencies and Banks in the best interest of our member factories.

The Board is broad based and consists of Government representatives drawn from various departments who render mature and competent advice to the Board.

TAMIL NADU CO-OPERATIVE SUGAR FEDERATION

No. 2 Maharaja Surya Rao Road, Madras-18

Telegraphic Address	COPSUFED, Madras
Telephone No.	Office-447083, 447884
Thiru M. Krishnaswamy	Special Officer/ Managing Director.
No. of factories affiliated	14
No. of working factories	12

The Co-operative Sugar Factories which started functioning from 1960, have now become 10 co-operative Sugar Mills with total daily crushing capacity of 16950 M.T. The two public sector sugar mills of 1250 TCD each have also become the members of The Tamil Nadu Co-operative Sugar Federation. The affairs of the Federation are managed by the Special Officer as the Committee of the Management has been dissolved with effect from 13.6.1976. Thiru M. Krishnaswamy Managing Director of the Federation is now the Special Officer. The Federation is arranging to purchase in bulk "A-twill" Gunnies and heavy chemicals, on behalf of all the member mills including Cauvery Sugars which is now under the control of Government of India. The free sale sugar of all the member sugar mills and Cauvery Sugar Mills is sold by the Federation through tender system.

The Federation has employed one Agronomist in the Cadre of Joint Director of Agriculture for Cane Research and Development work, one Entomologist has also joined the Federation during 1981, and a Parasite Breeding Laboratory is attached to the Federation with the objective of making available the Parasite for the Biological Control of 'Internode Borer' in sugarcane in the area of all the co-operative and Public Sector Sugar Mills. Both the Agronomist and Entomologist are also engaged in giving-in-service training to Factory Cane Staff by writing the respective mill in relation to the local problems besides arranging

for conducting big mill tests.

The Federation has also appointed one Instrument Engineer who looks after the working and maintenance of various instruments in cooperative and public sector sugar mills.

The Federation is also publishing a weekly news letter titled "Sugar News" giving important information on Sugar Industry besides Technical Information on Sugarcane Culture and Plant Protection etc.

During 1981 the Federation arranged a cane quality review meeting at state level for all sugar mills in Tamil Nadu and Pondichery with a view to suggest remedies for improving the sugar recovery percent in TamilNadu. As a result of a propaganda made and the seminars conducted by the Federation the rich quality cane Co. C 671 has already spread to considerable extent in Factory areas which has had a very good impact in getting higher sugar recovery. The Federation has also organised a seminar on Management Accountants of the Cooperative and Public Sector Sugar Mills during August 1981, utilising the valuable service of Mr. A. Mukherjee Chief Financial Advisor of the National Federation. Under the auspicious of the Tamil Nadu Institute of Labour and Studies, a training programme on personnel Function and Industrial Relations in Sugar Industry was also conducted by the Federation.

THE PUNJAB STATE FEDERATION OF CO-OPERATIVE SUGAR MILLS LTD.

SCO 128-129, 2nd Floor,
Madhya Marg, Section-8C,
CHANDIGARH

Tel : (O) 43882 (Managing Director)
32162 (Financial Adviser)
(R) 31824 (Managing Director)
32379 (Financial Adviser)

Gram : FEDSUGAR, Chandigarh

Telex : 0395 372 FED IN

Sh. Gurdev Singh, IAS, Managing Director.

Sh. Sushil Kumar, Financial Adviser.

Sh. H. C. Mahajan, Manager (Admn).

Sh. N. D. Varma, Sr. Sugar Technologist.

No. of factories affiliated 9

No. of working factories 7

An Apex Cooperative Institution at State Level to assist in the promotion, construction and operation of Sugar Mills and to facilitate and coordinate the working of such mills in the State of Punjab.

Having nine cooperative sugar mills affiliated to it, namely, at Batala, Bhogpur, Nawanshahr, Morinda, Rakhra (Patiala), Bodiwala Pitha (Fazilka), Budhewal (Ludhiana), Sheron (Tarn Taran) and Mehtpur-Gagarwal (Jalandhar).

Through each of these mills contributing to the socio-economic development of the State by

- (i) Offering the cane growers a remunerative cane price and participation in the management of the mills.
- (ii) Providing employment to a large number of people including landless labourers and marginal farmers from nearby villages.
- (iii) Mobilising rural savings for industrial purposes.
- (iv) Preserving individual status of farmers while conferring all the advantages of large sized industry.

U.P.CO-OPERATIVE SUGAR FACTORIES FEDERATION LTD.

9-A, Rana Pratap Marg,
Lucknow - 226 001.

Tel : PABX 42061, 42062, 42098 & 42153
Telex : 293 CSFF IN Gram : SUGARFED

No. of factories affiliated	30
No. of working factories	29

Sugar Industry in the Cooperative Field

The main objective of establishing sugar factories in the Cooperative sector is the economic resurgence of the population in areas in and around their areas of operation. The Chief beneficiaries of the sugar factories are the sugarcane farmers who stand to receive not only remunerative prices for sugarcane but various types of assistance for sugarcane cultivation. With these objectives in view, a new cooperative sugar factory was established for the first time in 1958-59 in Bajpur (Nainital). The prosperity of this sugar mill induced the establishment of two new cooperative sugar units in Bagpat (Merath) and Sarsanwa (Saharanpur). The year 1963 saw the formation of Uttar Pradesh Cooperative Sugar Mills' Federation with the aim that this Federation will assist the establishment of new units as well as facilitate representative, administrative assistance to factories already in working order. It was also intended that the Federation will render help in securing financial assistance from Credit Institution. All of these together would, it was surmised, improve working excellence of the sugar units. Sure enough, the tireless efforts of the Federation resulted in establishment of 28 working sugar factories by the season of 1985-86, the total crushing capacity being 40,550 tonnes per day. Creation of a sugar mill in Gadarpur was completed in 1986-87 and the sugar mill in Purvaya (Shahjahanpur) is being established to commence crushing operations in 1987-88 season. Besides these 4 new distilleries have been started with the total capacity of 1,40,000 LPD.

Progress in the 6th Five-Year Plan

Besides, successfully establishing 10 new units at Belrayan, Tilhar, Mehmoodabad, Gajraula, Sultanpur, Morana, Semikheda, Sitarganj, Nanpara and Ghosi, expansion was achieved of the mill at Bajpur from 1600 TPD to 3000 TPD, of the mill at Sarsawan from 1000 TPD to 1500 TPD, of the Bagpat mill from 1250 TPD to 1800 TPD, of the mills at Mazaula, Anupshahr, Nadehi, Bilaspur from 1250 to 2000 TPD.

Similarly, the total crushing capacity per day increased from 20,100 tonnes to 38,050 tonnes during the 6th Plan. The production of sugar increased from 13 lacs quintals to 30 lacs quintals.

Seventh Five Year Plan

In the Seventh Plan work on 3 new sugar factories each of 1500 TPD will be started in the cooperative sector as well as expansion of existing units is planned. The result will be 48,530 TPD crushing capacity of the sugar mills in the cooperative sector by the end of the Seventh Plan. Also, distilleries at Nanpara, Bagpat and Kayamganj will be set up. The total capacity of distilleries at Mazaula, Nanauta and Anupshahr will be increased from 30,000 LPD to 60,000 LPD. The end of the Seventh Plan will witness total Alcohol production amounting to 3,20,000 LPD. Production of various chemicals from Alcohol is also scheduled as also production of energy from effluents in four distilleries. Sugar Mills at Rasada, Badayun, Aurai, Sathianwa, Satha and other places will be restarted.

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(KAKASAHEBNAGAR)

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V. G. KHILARI
Managing Director

PANDITRAO N. BHOSLE BALASAHEB D. WAGH
Vice-Chairman Chairman

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